ROYAL PRINCE ALFRED HOSPITAL: ITS HISTORY AND SURGICAL DEVELOPMENT.

By H. H. SCHLINK.

THE first step towards the foundation of the Royal Prince Alfred Hospital was taken on March 20, 1868, at a public meeting convened for the purpose of showing the community's loyalty to the Crown and its appreciation of the recovery of His Royal Highness Prince Alfred, the Duke of Edinburgh, who had been shot by an assassin during his sojourn in Sydney.

The meeting decided to raise funds for the purpose of establishing a memorial hospital to be called the Prince Alfred. This fund was originally offered to the Directors of the Sydney Infirmary, provided that they changed the name of their institution to the Prince Alfred Memorial Hospital. They first accepted, but subsequently refused the offer, as they found the Government of the day unwilling to grant them a title to the land in Macquarie Street upon which the old infirmary stood.

In passing, it is interesting to record that the activities arising out of this offer of the Prince Alfred Fund were instrumental in securing for the directors the grant of the old infirmary site and by a change of name the Sydney Hospital came into being in the year 1881.

After much controversy and delay regarding the site for the Prince Alfred Hospital, the Senate of the University of Sydney, which had been contemplating the establishment of a medical school for some considerable time, solved the difficulty by offering (1871) the present position provided the proposed hospital was of a general character and provided it was open to the University to establish a medical school in connexion therewith.

In 1873 an act to incorporate the Prince Alfred Hospital was passed, and under its provisions the first board of directors was formed to
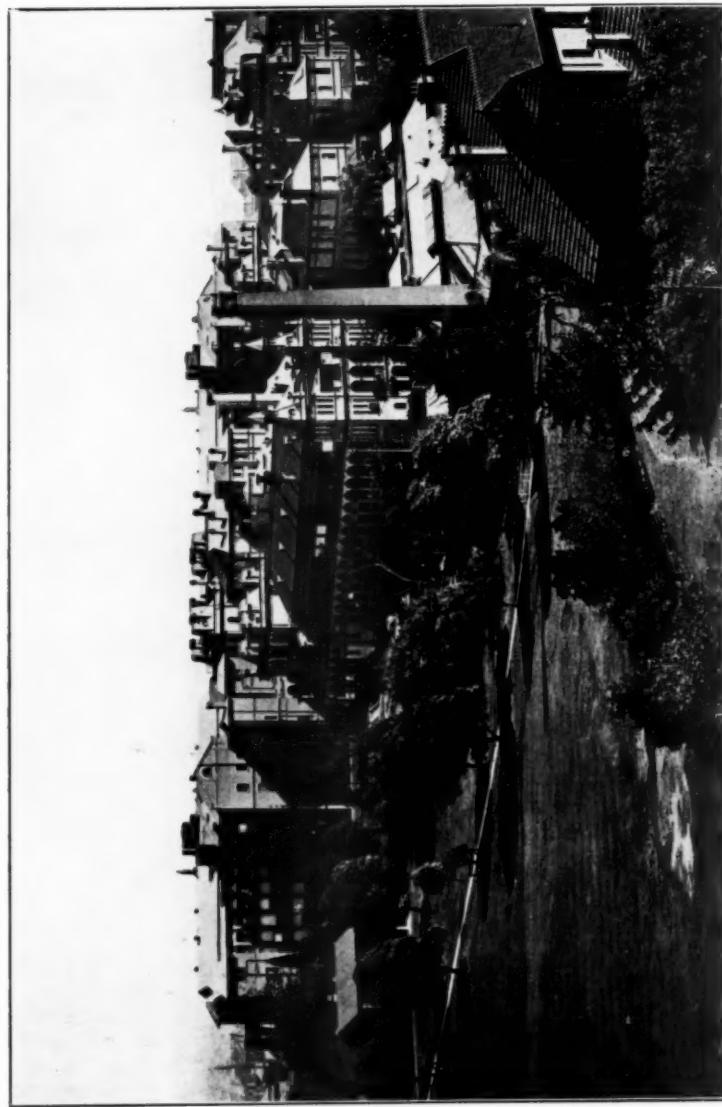
The Royal Prince Alfred Hospital.

manage the business side of the hospital and to sit with the Senate of the University as a conjoint board to appoint the medical staff and to exercise control over the students of medicine.

When building operations were about to start it was found that the money available was not sufficient for a large general hospital, and the Premier, Sir Henry Parkes, was appealed to for government aid.

His Royal Highness Prince Alfred, Duke of Edinburgh.

He refused and for a time the directors contemplated building a smaller hospital for children, but a change of Government brought a friend in the person of Sir John Robertson, who promptly came to the rescue with a government grant. Even on the day on which the tenders for the first pavilions were before the Board, Sir Edward Deas Thompson, who

was Chancellor of the University, nearly prevented their acceptance by proposing an amendment:

> That the further consideration of these tenders be postponed until a system of drainage and sewerage be submitted to and receive the approval of the Senate of the University, in conformity with the provisions of Paragraph 5 of Section 2 of the Act of Parliament, 36 Victoria, No. 28.

In the long discussion which ensued it was pointed out that the Act did not compel the Board to submit plans relating to sewerage to the Senate for approval and this inadvertently raised the whole question of the authority of the Senate in regard to the hospital. It was clearly laid down that the Senate was to be consulted only in the matter of honorary staff appointments, resident medical officers and medical students.

After years of unforeseen delay the general hospital was eventually built out of the Memorial Fund, aided by additional private donations and supported in successive years by liberal parliamentary grants. It was opened for the reception of patients on September 25, 1882, a year prior to the establishment of the Sydney Medical School.

Thus there were fourteen years between the inauguration of the movement and the opening of the hospital, a delay which caused the public to doubt if it were ever going to be built, so much so that a topical singer in one of the musical comedies of the day gave the matter his attention and sang:

> It was the Hospital built by subscription,
> When poor Alfred's life was at stake,
>   [*He turns and looks at a blank screen hanging behind him*]
> Hello, there's no Hospital there to be seen,
> And that's where I make my mistake.

However, no Australian hospital was opened under more august patronage. The Duke and Duchess of Edinburgh had already consented to be patrons. Later Her Majesty Queen Victoria acceded to the request that she should act as patroness and finally it was announced that Their Royal Highnesses the Prince and Princess of Wales, afterwards King Edward and Queen Alexandra, had similarly honoured the hospital. The Princess of Wales further expressed the wish that the Children's Ward should bear her name, and it has been called "the Alexandra" to this day. The sons of the Prince of Wales, Princes Clarence and George, visited the hospital in 1881 and left their autographed photographs, and twenty years later one of them, Prince George, then Duke of York, and his young wife, who were in Australia for the purpose of opening the Commonwealth Parliament, visited the hospital to lay the foundation stones of the two Queen Victoria Memorial Pavilions, and finally as King and Queen of England they graciously allowed themselves to be termed patrons. The present Prince of Wales on his visit to Australia allowed his name to be attached to the block of buildings now about to be opened as the new professorial unit. The hospital's title "Royal" is therefore fully warranted.

Among the many famous names that stand out in association with the foundation of the hospital are those of Sir Alfred Roberts, Sir Edward Knox, Dr. Norton Manning, Mr. John Fairfax, Mr. Grafton Ross, Sir Alfred Stephen, Sir James Fairfax, Sir William Manning, Mr. H. E. A. Allen and Sir Phillip Sydney Jones. To these men, and in particular to Sir Alfred Roberts, must be given the credit of building and organizing
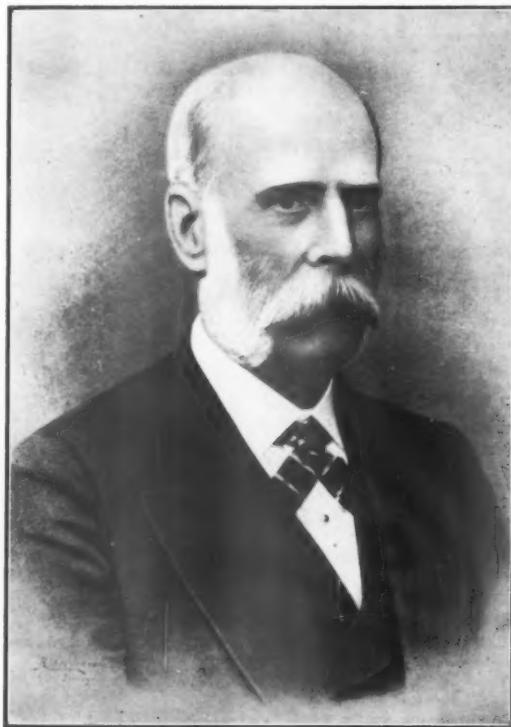
Sir Alfred Roberts.

an up-to-date institution, capable not only of treating the sick poor, but of educating students of the proposed Medical School.

It may be of interest to note that, although the prominent clergy of the day participated in the early activities of the fund, they were excluded by Clause No. 10 of the Act from holding office as directors, not as a slight or indignity, but because, as it is stated, the framers of the Act were convinced of the growing necessity of doing away with sectarian influences in the management of charitable institutions.

By the wisdom of the founders a close cooperation between the University Senate and the hospital was established, and was made closer by an agreement made in 1888 by which the lecturers in medicine, surgery, ophthalmic diseases and gynæcology were appointed to positions on the honorary medical staff of the hospital in virtue of their lectureships. This wise arrangement and the agreement to appoint all honorary medical officers by the Senate and Board conjointly have always insured a high standard of clinical teaching in the hospital.

Next to Sir Alfred Roberts, one of the most indefatigable workers in the early days of the hospital was Sir Edward Knox, who acted as treasurer to the original fund and was Chairman of Directors almost continuously from 1889 to 1901, dying in office. Upon his death, Sir Thomas Anderson Stuart, who was Dean of the Faculty of Medicine, and had been an ordinary member of the Board since 1883, took control and commenced a very active administration. His first act was almost to double the bed accommodation (236 to 518) by the erection of the Queen Victoria Memorial Pavilions, which greatly improved the facilities for clinical teaching. Without detracting from the merits of others, it might be said that Sir Alfred Roberts and Sir Thomas Anderson Stuart are the two outstanding figures in the building and development of the hospital on the administrative side.

In opening the Queen Victoria Pavilions, Sir Thomas met with the same financial difficulties and disappointments as confronted Sir Alfred at the beginning. The pavilions were built, furnished and ready for occupation in 1907, but the State Government which had generously subscribed to their construction, failed to provide any additional bed subsidy, and so it was not until the Federal Government took over the beds for returned soldiers in 1918 that the new pavilions were fully occupied. In 1926 the Commonwealth authorities withdrew their subsidy and shifted the soldier patients to the Randwick Military Hospital. Upon the promise of an extra subsidy by the authorities, which, however, was not fulfilled, the directors made the vacated beds available for civilian patients. This imposed extra financial burden was carried until 1931; by this time every possible source of revenue was exhausted, the bank overdraft stood at £105,000, and the tradesmen's dues were months in arrears. The directors were therefore reluctantly compelled to close two hundred beds, and these remained closed until this year (1933), when by the generosity of the State Government in providing extra bed subsidy through the Hospitals Commission their reopening was made possible.

After the death of Sir Thomas (1920), the Honourable H. E. Kater, who had given valuable services as treasurer and had been a director since 1892, was elected to the chair, and continued to conduct the affairs of the hospital until his death in 1923. Dr. Cecil Purser was then elected chairman. He had been a medical superintendent, 1891 to 1893, an honorary physician, 1896 to 1912, and a member of the Board of Directors since 1909. To him fell the task of steering the hospital through

Anderson Stuart

its darkest period of financial stress, and he deserves high praise for the able manner in which he conducted the administration, especially as it was a period when the public demands on the hospital were greatest and when the creation of new and the expansion of old departments were almost yearly occurrences. After ten years of honourable and arduous service he resigned this year (1933), and Sir Samuel Hordern, who had been on the Board since 1913 and Vice-Chairman since 1924, was appointed in his place.

Members of the College will, however, be more interested in the surgical history of the Royal Prince Alfred Hospital. To illustrate the development of the professional side, it is only necessary to mention that the original honorary staff consisted of nine men and two resident medical officers, and that now there are one hundred and eighteen honorary medical officers attached to the various departments, with twenty-eight resident medical officers and three whole-time paid officers, a morbid anatomist, a bacteriologist and a biochemist.

The first two general surgeons were George Fortescue and W. H. Goode. Fortescue was reputedly a brilliant surgeon in the operations of the day, which appear from the annual reports to have been mainly amputations. He died in office three years after his appointment. Goode was a surgeon of the old school who was, if report be true, very loath to have resort to cutting operations, and depended almost solely on surgical manipulation and other bloodless procedures. He resigned after six years, and ultimately became the University Lecturer in Medical Jurisprudence. Their assistants were G. T. Hankins and G. E. Twynam, who succeeded them on the full staff. Goode and Hankins were the first clinical lecturers in surgery. The only other member of the original surgical staff was Thomas Evans, in charge of ophthalmic surgery. S. T. Knaggs was a senior surgeon on the staff from 1889 to 1893, and Dr. Milford, the first lecturer in surgery, was a senior surgeon for a short period prior to 1889.

The number of surgical operations in those early days was very small (147 in 1883) compared with the present day when about 10,000 are performed annually. The knowledge of antisepsis and asepsis was very crude, operations being performed in old bloodstained frock coats. Lister's discoveries (1867) had not yet penetrated to the Antipodes. With the appointment of Dr. Alexander MacCormick a revolution in surgical methods took place. This young Scotchman, brought up under the influence of Listerian surgery and fresh from the anatomical room of the new Medical School, where he was demonstrator, soon created a sensation by his successful and to the older generation apparently daring surgical triumphs. To their amazement his wounds did not show laudable pus, there was no secondary hæmorrhage, although he used plain catgut instead of silk even for the big arteries, and strangest of all his patients almost invariably recovered. He succeeded Dr. Milford as lecturer of Surgery in 1890, and soon developed an enormous reputation in

Sydney and throughout the State of New South Wales, and later throughout Australia. He continued to influence and guide the surgical destinies of Prince Alfred Hospital for twenty-five years, and helped to make it one of the best known surgical hospitals in Australia.

Following closely came another doyen of Prince Alfred Hospital surgery, the late Sir Charles P. B. Clubbe, who acted as a clinical

Sir Alexander MacCormick.

lecturer in surgery and concentrated in his later years on surgical diseases of children. His epoch-making work on intussusception carried his fame throughout the world. He was also justly famed for orthopædic surgery, of which he was one of the pioneers in this country. He was one of the chief founders of the Royal Alexandra Hospital for Children, and had the pleasure of seeing it grow from a small cottage in Glebe Point to the magnificent structure in Bridge Road, probably one of the largest children's hospitals existent (351 beds).

Now the first graduates of our own medical schools appear on the scene. The first, John F. McAlister (Melbourne School), was appointed to the staff. He had previously acted as Medical Superintendent, and had a short but brilliant career, as he died two years after his appointment to the honorary staff. Next came the first graduate of the new Sydney School in the person of the late H. V. C. Hinder (1899). Hinder was a man of outstanding personality and one of the finest surgical diagnosticians on the staff. He was a clinical lecturer in surgery, and took especial interest in urological diseases, and his published lectures on this subject could be read today with interest and advantage despite the great strides that this branch of surgery has recently made. In his earliest days he advocated the suprapubic approach for prostatectomy, although his seniors and general opinion favoured the perineal method. How right he was is evidenced by the practice of today. On account of his celerity there was no man more fitted to remove a ruptured spleen or to deal with an acute surgical emergency than he. He died in the full bloom of his surgical career through an infection contracted while operating.

Other than the present active staff, five men have given long and honourable service to the Department of General Surgery. Three of these—G. H. Abbott, John Morton and St. J. W. Dansey—are still Honorary Consulting Surgeons, and their brilliant careers are fresh in the minds of all. Two are dead: Charles MacLaurin, appointed 1897, and R. Gordon Craig, appointed 1900. The former, apart from the many practical surgical innovations he introduced into hospital practice, for example the use of rubber gloves and face masks, was a brilliant writer, and contributed many articles on literary as well as surgical subjects. Probably his best known work is "Post Mortem". Gordon Craig possessed a great surgical dexterity. He was eminently a practical man and an enthusiastic organizer. He was worked so hard that he had little leisure to do much writing. Towards the end of his active career he concentrated on the establishment of a Urological Department, and gave up his general work and became the first Senior Urological Surgeon (1926). He gave £20,000 to the University of Sydney to establish Fellows in Urology and was a great benefactor to this College of Surgeons.

In the beginning there was only one special surgical department, the ophthalmological, which was conducted by Thomas Evans (1882 to 1889). F. Antill Pockley joined him as an assistant in 1887 and became a full Honorary Surgeon in 1889 in virtue of being appointed Lecturer in Ophthalmology. They were assisted by S. H. Hughes (1898), H. Guy S. Warren (1902) and J. C. Halliday (1906). The founders of this department have brought it to a high degree of efficiency.

Less than two years after the hospital was opened, a second special surgical department, that of gynæcology, was established (1884), with Joseph Foreman as the chief. He served the hospital as Gynæcological Surgeon for a continuous period of thirty-five years, except for a break of one year in 1897, after which he returned to the staff as Lecturer in Gynæcology. His sound judgement, his operative dexterity, his wisdom,

his unfailing courtesy to both seniors and juniors, as well as his patience in teaching students, have left one of the finest monuments to hospital service. Thomas Chambers, who was the first Lecturer in the Diseases of Women at the University, occupied the senior gynæcological position for one year, after which he resigned (1897). He is reputed to have been the first man to have done an ovariotomy in Sydney. Edward E. T. Thring joined the staff as an assistant gynæcologist in 1889, and was made a full honorary gynæcologist in 1897. The excellence of his operative technique was known throughout the State, and he was the first surgeon on the staff to perform a radical panhysterectomy with preliminary vaginal cuff (1898) for cancer of the cervix. Taylor Young (1902) and Fourness Barrington (1906) joined the staff of this department and assisted to maintain the high standard of gynæcology for which the Sydney School is renowned. Mr. Barrington was lecturer in gynæcology from 1920 to 1924. In few cities of the world has this subject been so specialized as in Sydney, and for this we must thank the sound principles laid down and the energy displayed by the founders of the department.

The third special surgical department, Ear, Nose and Throat, was not formed until 1898, when the late G. T. Hankins gave up his general surgical position and became its first head. He was joined by the late H. Russell Nolan (1903) and the late Herbert J. Marks (1906). Without detracting from the efforts of the other two men, the chief credit of developing this department to its present eminent position must be given to Herbert J. Marks, who served for eighteen years and succeeded Russell Nolan as lecturer in this subject.

Only two other special surgical departments exist in the hospital: first, the Orthopædic Department, which was created in 1920, and the Department of Urology, created in 1926. Both have proved the wisdom of specialization when placed under proper direction.

RADIOLOGY.

In 1928 the Commonwealth Government purchased £100,000 worth of radium, and decided to open centres for the treatment of cancer in each of the principal cities. The Royal Prince Alfred Hospital was selected as the first radium centre for treatment in Sydney. Just prior to this the University of Sydney had established a Cancer Research Fund, which reached £130,000, and appointed Dr. F. P. Sandes Director of Cancer Treatment. It was due to his energy and enthusiasm that the present well organized Radium and Deep X Ray Departments were established at the hospital.

CLINICAL SCHOOL.

The hospital holds a unique position not only in Australia, but in the Empire, because it was founded as a University hospital built on University ground, and because all honorary appointments on the medical staff are made by the Senate and Board of Management conjointly, and
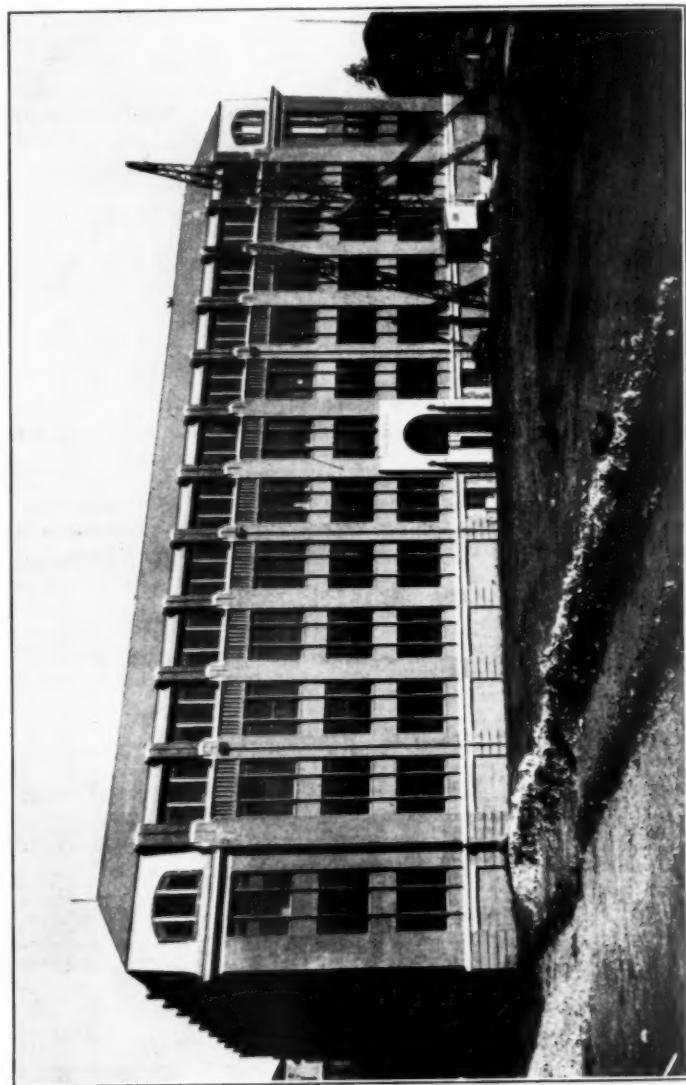
The Rockefeller Building.

from the fact that the professors and lecturers appointed by the Senate hold positions on the staff in virtue of those appointments. The school started in the year 1884, when the University made arrangements for a course of hospital clinical study in accord with the University curriculum. Fourteen students entered their names upon the hospital books. In this way began the hospital's connexion with the Medical School, and, judging by the records, the relations with the University have always been harmonious, as they should be between great public institutions so closely interrelated in their work and objects.

At the beginning lecturers in the following subjects were on the hospital staff: medicine, surgery, ophthalmology and gynæcology, and later one clinical lecturer in medicine and one in surgery were added. The number of clinical lecturers was ultimately increased to six, and in addition a tutor was appointed for each of the first two subjects. In 1902 Professor Welsh was appointed as Honorary Pathologist and in 1908 Professor H. G. Chapman was appointed as Honorary Pathological Chemist. Thus the connexion with the University became closer, and in the years 1919 and 1921 respectively the lecturers in medicine and surgery, Dr. Arthur Mills and Dr. F. P. Sandes, were created professors with the right to private consulting practice.

The clinical school was growing and developing, when fresh impetus was given to it by the magnificent benefaction of Mr. George Bosch of over £200,000 to provide full-time professors of medicine, surgery and bacteriology. Professor C. G. Lambie, Professor H. R. Dew and Professor H. D. Wright were appointed in 1930 to direct clinical teaching and research. Closely following on this benefaction, the Rockefeller Foundation made a magnificent gift of half a million dollars for the erection and equipment of a new building for medical teaching and research. This building is being erected partly on University and partly on hospital ground, and is connected by an overhead passage with the ward reticulation. The building, which is now nearing completion, will be among the largest and best equipped schools in the world. Quite recently the Professor of Bacteriology and the Professor of Physiology were made honorary officers of the hospital so that the relation between medical school and hospital has been further strengthened. Thus the clinical school which started in 1883, with fourteen students, has grown, and has continued to increase until no fewer than 1,944 students have been registered as possessing the privilege of hospital practice. Among these are to be found the names of many men of great eminence in the world of medical science, chief of whom is Professor Grafton Elliott Smith, now Fullerian Professor of Physiology at University College, London, and many other men who are now at the head of the profession in Australia.

ANDERSON STUART OPERATING PAVILION.

The surgical work of the hospital very early became a feature of its general system. The number of operations in 1883 (147) rapidly and progressively increased until an annual turnover of 10,000 was reached

when the hospital was running full capacity. Naturally this needed an
ever increasing theatre accommodation; the plan of expansion adopted
was the system of each surgical block being self-contained with its own
theatre.   Shortly before the war, further expansion of theatre accom-
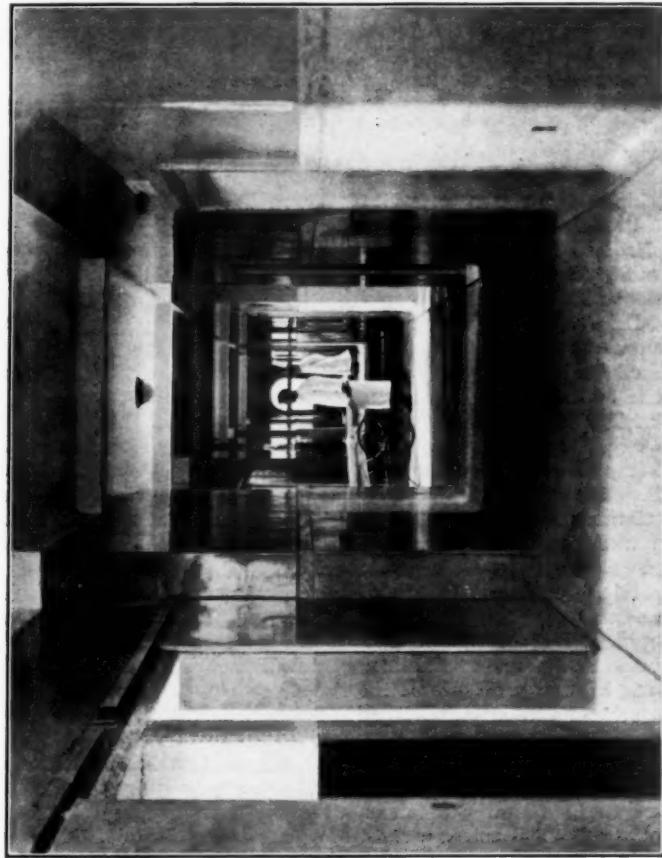
The Anderson Stuart Operating Pavilion Corridor.

modation was necessary. As the advantages of centralization had already
been proved in Europe and America, the surgical staff soon recommended
that an operation pavilion, in lieu of theatres scattered throughout the
hospital, should be built. Thus a unique feature of the hospital came into
being, a pavilion with eight operating theatres and a plaster room facing

south light, separated by a long central corridor from the anæsthetic, the wash-up, the sterilizing, the pathological, the radiographic, the instrument, the recovery and the dressing rooms. Many visiting hospital architects expressed the opinion that it would prove unworkable on account of the corridor traffic when eight theatres were in use. This opinion has proved to be quite wrong; in point of fact, the advantage of having the surgeon and his assistants out of the way when washing up and dressing are being done has proved an absolute boon to the nurses arranging the theatre for the next operation. The colour scheme is hospital grey, and the lighting scialytic or daylight, except for one theatre, which is camera black and artificially lit by a Shubert shadowless light. In this theatre dark blue gowns and linen are used so that the eyes are rested when not actually looking at the wound. The light has proved a great success, especially for deep pelvic work and ophthalmic surgery. The hospital feels justified in claiming to have one of the most modern, original and practical operation pavilions in existence.

CONCLUSION.

The Prince Alfred Memorial Fund has proved a great benefit to the sick and maimed of the State, for whom it was originally subscribed. In-patients to the number of 248,174 and 1,118,973 individual out-patients who made 3,544,993 visits, have received relief since 1883. It has helped the development of Australian surgery, 182,924 operations having been performed. It made possible the expansion of the Medical School, which has provided the State with 2,326 medical practitioners, of whom 566 became resident medical officers for one or more years after graduation. It has completely trained 1,000 nurses as well as many lay technicians.

Out of every evil comes some good. For however much we deplore the sad event which led to the inauguration of the Hospital Memorial Fund, we have the consolation that by means of this fund a great hospital has come into being within whose walls physicians, surgeons, matrons, nurses and technicians have been and are being trained to occupy useful positions in the community and to help to staff the numerous hospitals, both large and small, throughout the State of New South Wales.

D

SOME CLINICAL SYNDROMES OF THE FIFTH CRANIAL NERVE.

By Harold R. Dew.

[From the Department of Surgery, University of Sydney.]

WHILE the typical fifth nerve syndrome, trigeminal neuralgia, is so well known as to merit no discussion here, it is not recognized by clinicians generally that this nerve can be affected by a great variety of other lesions, both inflammatory and neoplastic. This fact has recently been emphasized by Stammers,[1] who recorded an interesting series of both these types from the Mayo Clinic, while small series or isolated cases of tumours have been recorded by numerous observers during the last decade.

Owing to its large size and the fact that its roots and ganglion lie in both the middle and posterior fossæ of the skull, it is somewhat surprising that involvement of the fifth nerve by tumours is not more common. This is probably due to the facts that primary tumours of nervous or ganglionic tissue are very rare in any situation, and that in this particular case the presence of a dense enclosing sheath of *dura mater* precludes invasion of the Gasserian ganglion by adjacent neoplasms.

Increasing experience has shown, however, that cases with tumours affecting this nerve either primarily or secondarily constitute definite clinical entities, often with rather characteristic symptoms. The following discussion, in which advantage is taken to review the literature briefly, is based upon a detailed study of five cases in which a tumour involved the ganglion or one of its main divisions. The cases illustrate very well some of the clinical syndromes, and also serve to show the diagnostic errors that are possible unless these are duly appreciated.

CLASSIFICATION OF THE TUMOURS.

The ganglion or its main roots may be involved either by primary or secondary neoplasms as follows:

1. Tumours derived from the ganglionic tissues: neurofibromata, ganglioneuromata, endotheliomata, meningiomata.

2. Tumours derived from the meninges of the base of the brain, or from the brain: meningiomata, gliomata.

3. Tumours of the *Nervus acusticus* and cerebello-pontine angle: neurofibromata, meningiomata.

4. Tumours of the maxillary antrum: carcinomata.

5. Tumours of the naso-pharynx involving the cranial base by direct extension from below: fibrosarcomata, carcinomata, lymphosarcomata.

6. Metastatic tumours: carcinomata, sarcomata.

1. Primary Tumours.

Primary tumours are very rare, but owing to the fact that in many of the cases recorded no distinction was made between tumours involving the ganglion by direct extension from the meninges or other structures and those originating in the ganglion or its sheath, their true incidence is difficult to assess. Peet,[2] in a brief review of the literature, stated that up to the end of 1926 he could find records of sixty-three tumours of all types, the pathological diagnosis of the majority being endothelioma. The others were variously diagnosed as sarcoma, neurofibroma, glioma, carcinoma, osteochondroma, neuroblastoma, lymphosarcoma and adamantinoma—evidence of the fact that they could not all be classed as primary tumours originating from the ganglion or its covering.

In spite of Frazier's[3] statement that practically all these tumours originate from the dura or some other structure of the middle fossa, there seems little doubt that in some cases the tumour actually arises from some of the ganglionic cells or from its sheath and that, as Cushing[4] points out, they may remain for a long time extradural.

Pathological Histology.

As might be expected, there is great diversity of opinion concerning the exact nature and histogenesis of primary tumours, the diagnosis of sarcoma, neurofibroma, ganglioneuroma and endothelioma having been given by different observers. The majority of writers use the term endothelioma, although some state that the characteristic cell of many tumours seems to be more or less carcinomatous in appearance. Ewing[5] is very non-committal with regard to their histology. He may be quoted:

The structure has varied from fibrous to very cellular growths, the latter presenting alveoli surrounded by several layers of polyhedral cells. In some the structure resembles perivascular endothelioma. In others gliomatous features were noticed. Machard believed that they represented various types of neurocytomata, others have derived these tumours from the pericellular lymph sheaths.

Cushing suggests that the majority of them are meningiomata, that, like these growths elsewhere, they are primarily derived from the arachnoid villi of the region, and that typically their structure is very like that seen in classical meningeal growths. Stammers, in reviewing a series from the Mayo Clinic, states that, as in most of these neoplasms the ganglionic tissue appears to be actually infiltrated with neoplastic cells, the appearance is somewhat unlike that seen in cases of typical meningiomata. In the latter the brain tissues are never involved, but simply indented; and he suggests that in most of the recorded tumours of the Gasserian ganglion the neoplasms have been derived from

endothelial cells within the ganglion or are meningiomata with some sarcomatous change.

It would seem that he has not made sufficient allowance for the confined space in which the tumour must develop, nor for the fact that in the main the ganglionic tissue seems to be destroyed by direct pressure and not by true infiltration. There is no doubt, however, that possibly because of the above factor the cellular structure is somewhat different from that of typical meningiomata in that the tumour is more cellular, somewhat more vascular and more liable to cystic change. The slow rate of growth, too, as shown by the relatively long histories, is very suggestive of simple meningiomata rather than of sarcoma or endothelioma.

The apparent confusion which exists in various articles on these tumours, the difficulties of histological diagnosis which have been emphasized by many, and the frequency with which epithelial cells and appearances are described, are, I believe, in many cases due to the inclusion among primary tumours of unrecognized extensions of carcinoma from neighbouring regions.

Clinical Aspects.

From a study of the reported cases it seems that these tumours, in that they immediately involve the ganglion or its adjacent coverings, and so rapidly irritate or compress its cells, give rise to a definite series of clinical manifestations which are easily recognizable and constitute a true clinical syndrome.

Onset. Irritation of the ganglion is at first shown by gradually increasing pain in the area of distribution of the nerve. At first the pain is spasmodic, so that the simulation of trigeminal neuralgia may be accurate, but very soon it becomes continuous and uninfluenced by local treatment or drugs. The distribution and spread of this pain depend, of course, on the portion of the ganglion first affected—in some cases starting in the ophthalmic, in others in the mandibular division. The pain gradually becomes more persistent and ultimately unbearable; it may involve the whole of the tongue and oral cavity, the teeth, the skin of the face, and even radiate to the back of the head and neck, as in the case recorded by Walton Smith and Bradley.[6] Sometimes the constant pain is varied by the onset of terrible exacerbations. During this stage, which usually lasts for some months, facial hyperæsthesia is often present.

The pain is followed by a feeling of numbness over some portion of the distribution of the fifth nerve, as a rule just over the lip area, but sooner or later the ophthalmic area is also affected. At the same time, examination reveals varying degrees of sensory loss over the area, and the cornea may be found to be insensitive and to have lost its character-istic reflex, signs of neurotrophic keratitis with actual ulceration not uncommonly developing. It is the peculiar combination of severe con-

stant pain with actual sensory loss or anæsthesia over the same area which is the pathognomonic feature of this lesion.

Motor Phenomena. As is to be expected, the motor root of the fifth nerve does not often escape, and in some cases the muscles of mastication become paralysed and atrophied, although this is often missed on clinical examination. Sometimes, as in the cases recorded by Shelden,[7] owing to the action of the pterygoids of the opposite side, the jaw may be deviated somewhat to the side of the tumour. In some cases, as evidenced by the condition of the soft palate, the *tensor palati* muscle is also paralysed.

Pressure on Neighbouring Nerves. Owing to its position, the sixth cranial nerve is frequently affected with consequent diplopia from paralysis of the external rectus of the homolateral side. Many of the reported cases showed this. It is strange that, in spite of its proximity, the third nerve has not been reported affected in nearly so many cases, nor has the fourth nerve been often implicated, although such a case has been recorded.

Intracranial Extension. Although both Cushing and Frazier mention the occurrence, it seems that, such is the resistance of the dura, extension of these tumours upward into the middle fossa and the temporal lobe is uncommon. However, uncinate attacks have been reported by Frazier, although it is not quite clear that he was not describing a primary meningioma of the basal meninges rather than a true primary tumour of the ganglion. As Cushing points out, there is rather a tendency on the part of a growth in this situation to erode the underlying bone, to distend the dura over the ganglion and to crowd back through the main fifth posterior root tunnel in the dura and so make its way into the posterior fossa, where it may reach a large size and simulate a primary tumour of the cerebello-pontine angle. Such an extension was also present in the cases recorded by Hellstein.[8]

In this way the eighth nerve may become involved by direct extension so that tinnitus and deafness may be comparatively early phenomena. It is interesting to note that in the case reported by Bradley and Walton Smith peculiar clicking or flipping noises in the ear of the affected side were a distressing feature. It was suggested by these observers that this may have been due to alterations in the tension of the tympanic membrane from involvement of the nerve to the *tensor tympani* muscle. It would seem, however, from the findings at autopsy, that direct involvement of the of the eighth nerve was the probable explanation.

In the cases quoted by Shelden[9] symptoms such as difficulty in swallowing, paralysis of a vocal cord and paresis of the sterno-mastoid muscle were noted; and, although accurate *post mortem* findings were not recorded, it is probable that these were due to actual direct pressure on the ninth, tenth and eleventh cranial nerves at their point of exit from the posterior fossa, the co-called "jugular syndrome".

From a study of Shelden's cases it would appear that some of these were certainly not primary tumours of the ganglion, but rather extensions

of extracranial tumours into the region of the jugular foramen, here again confusion being introduced into the records because the cases were not clearly classified pathologically. It is extremely rare for primary tumours to involve nerves placed so posteriorly, although, as will be seen later, these nerves are often involved in some other tumours.

Case I.—Primary Meningioblastoma of the Gasserian Ganglion.

M.B., a female, aged twenty-six years, a machinist by occupation, when first seen in the practice of Mr. Richard Flynn, complained of dizziness, noises in the head, increasing deafness, vomiting, failing vision and difficulty in swallowing.

The patient first noticed that her sight was failing twelve months before examination, when she consulted an optician, who fitted her with glasses. It subsequently transpired that during the first six months of her illness she suffered from intense neuralgic pains on the right side of her face, so severe that her parents were rather philosophical with regard to her post-operative death. The patient, however, made little complaint about this at the time of examination, and apparently the severity of the pain had passed off. Three months after the onset she began to have what she described as "fainting turns", each of which lasted for two to three minutes. At about this time she noticed that she was becoming deaf, this deafness gradually becoming extreme. Six months later she first began to suffer from morning vomiting, which persisted regularly for two months, since when she had only vomited on a few occasions. Quite recently she had had some difficulty in swallowing and, particularly while eating cereals, some had tended to come back through the nose. She had also noticed some instability in her gait, and when she got out of bed suddenly tended to have a "fainting turn". There were no symptoms referable to any of the other systems.

On examination, the patient was well nourished, not anæmic, and on an examination of the general systems nothing abnormal was detected.

Nervous System. The patient was intelligent and cooperative, although she complained that her memory failed her now and then.

Cranial Nerves. Examination of the fundus showed bilateral papillœdema of three to four diopters. The fields of vision were not investigated. In regard to the third nerve, nothing abnormal was detected in muscle movement, but the right pupil showed a very sluggish reaction to light. Nothing abnormal was detected in the fourth nerve. Sixth nerve—the right external rectus was paralysed. At the same time the ophthalmologist reported the presence of marked ptosis on the right side, and ulceration of nearly the whole of the right cornea, which was quite insensitive. The patient had complained of pins and needles sensations over the area of distribution of the right fifth nerve, particularly during and after what she described as one of her "turns". Complete anæsthesia was present over the distribution of the ophthalmic division and partial anæsthesia over the upper part of the region innervated by the maxillary division. No investigation was made at the time with regard to the power of the muscles of mastication. Seventh nerve—no facial paresis was present. Eighth nerve—nerve deafness was present on the right side. Bárány tests were carried out and the results seemed to confirm the diagnosis of a right cerebellar lesion. Ninth and tenth nerves—taste was normal, but there was some palatal paresis on the right side and some difficulty in swallowing.

The superficial abdominal reflexes were present on both sides, while the knee jerks were equal and active, no patellar or ankle clonus being present. The Achilles jerks were equal and active, while the plantar reflex showed a flexor response on both sides.

There was apparently more power in the left arm than in the right. The gait was unsteady, not spastic, but the patient tended to deviate to the right on walking. Romberg's sign was not present. There was horizontal nystagmus in both eyes, details of which were not noted. Further investigations as regards the ataxic gait and other cerebellar manifestations were not carried out. The

radiographic report was "a small bony projection in the right temporo-parietal region—nature uncertain". The diagnosis of cerebello-pontine angle tumour was made after several consultations.

Operation. A suboccipital decompression was first performed, combined with tapping of the left lateral ventricle during operation. The right side of the cerebellum appeared to be tenser than the left. The patient improved somewhat after this operation; the headache and tinnitus disappeared, while she thought that her other symptoms were less marked. The corneal ulceration also rapidly cleared up under antiseptic treatment. Three weeks later the posterior fossa was fully explored through the same incision and a cystic collection was discovered in the right cerebello-pontine angle and simply evacuated. The wound was sutured in the usual way. Death occurred twelve hours later from sudden respiratory failure.

FIGURE I. Primary tumour of Gasserian ganglion with cystic extension into the posterior fossa, the cystic portion being here much collapsed due to *post mortem* puncture and fixation. Oblique view to show projection of the tumour.

Autopsy Findings. After removal of the calvarium the brain was removed. During this process a loculated cyst was found growing from the sheath of the Gasserian ganglion back into the posterior fossa in the region of the cerebello-pontine angle, the petrous temporal bone in this area being much eroded. Nothing abnormal was detected in the other organs.

Pathology of the Tumour. Macroscopically the tumour had completely obliterated the right Gasserian ganglion, had expanded its sheath and caused some erosion of the underlying petrous bone. The portion of the growth in this situation was firm and somewhat nodular, roughly ovoid in shape and measured 3·5 by 2·0 centimetres. The dural canal for the main sensory division of the nerve was so expanded as to be unrecognizable and the tumour had extended back into the posterior fossa where in the cerebello-pontine angle it enlarged into a loculated cystic swelling, somewhat larger than the anterior firm portion. This swelling had caused pressure on the eighth cranial nerve which appeared to be more or less obliterated. There was in addition some pressure deformity of the pons and lateral lobe of the cerebellum. The fluid contained in this cystic portion was yellowish in colour, but no further examination as to its nature was performed.

Sections of the complete tumour were taken for examination by special staining methods. With hæmatoxylin and eosin it was found to contain areas of degeneration with some intercellular hæmorrhage and cystic and hyaline areas, in the midst of large sheets of well staining neoplastic cells. No ganglionic cells or nervous structures could be detected by any of the well recognized special staining methods, and the cellular type seemed to be remarkably homogeneous and regular. Throughout the section, areas of lymphatic infiltration were commonly seen. The typical cell was small, rounded or oval in shape, and well supplied with nuclear chromatin. Certain areas, however, showed a tendency towards the formation of fibrils and whorls of cells, and after much deliberation the diagnosis of meningioblastoma was arrived at.

It is probable that this tumour originated, as Cushing believes the majority of them do, from the arachnoid villi of the sheath of the ganglion, that nervous elements played no part in its histogenesis, and that these had been obliterated by pressure effects. It is certainly much more cellular and more embryonic in its appearance than the typical fibrous meningiomata so well known as an intracranial neoplasm, and for this reason has been classed as a meningioblastoma.

There seems little doubt that this tumour actually originated inside the sheath of the ganglion itself, giving rise to irritative phenomena followed by sensory and motor loss and finally complete destruction of the ganglion and that portion of the main sensory root in its dural canal. The latter was destroyed by the crowding of the tumour back into the posterior fossa, where it formed a cystic tumour in the cerebello-pontine recess. The more or less complete cessation of pain is of great interest in that it suggests that the added room allowed in this area precluded further pressure effects on the effective sensory fibres left. It was the relative absence of pain in the later part of the story with the coincident eighth nerve and cerebello-pontine angle tumour syndrome that led to the exploration of this area. This emphasizes the importance of obtaining the symptoms in definite chronological order in order to assess their true value. In these cases the sequence, pain, anæsthesia, auditory phenomena, cerebellar symptoms, is really in marked contrast with the relatively late occurrence of fifth nerve symptoms in true tumours of the angle. It is important to note, however, that Cushing, Frazier, Sachs and others all emphasize the possibility of this error. Cushing records a case in which tinnitus was noticed nearly a year before the pain commenced in the face, and at the time of examination there was complete deafness of nearly a year's standing, numbness in the upper parts of the face, third and sixth nerve palsy, and severe ophthalmic pain. Radiography showed an erosion of the lateral part of the *sella turcica*. Operation revealed some intradural extension of an meningioma under the temporal lobe, the ganglion being almost obliterated by the growth, and also an extension into the posterior fossa. Cushing also records a fatal case of the opposite type of error in which a negative operation on the Gasserian ganglion was undertaken for symptoms which presumably were due really to a tumour of the cerebello-pontine angle.

Frazier has also commented upon the difficulty of diagnosis from cerebello-pontine angle tumour. He, too, emphasizes the fact that in typical cases tumours of the angle involve the eighth nerve early, pain in the region of the fifth nerve coming on relatively later and in the average case not being a marked feature.
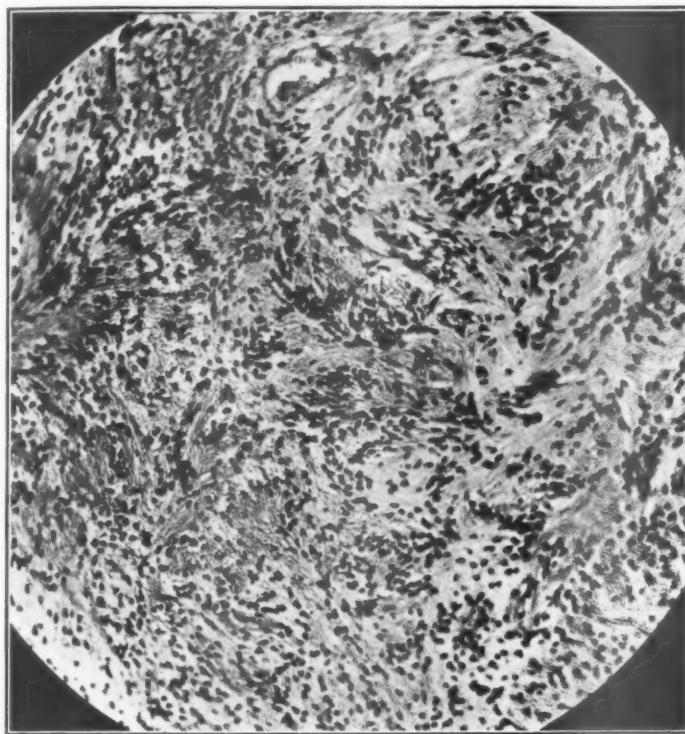

FIGURE II.   Microscopic appearance of primary tumour of the Gasserian ganglion.   Case I.

2. Tumours Derived from the Meninges or Brain Above the Ganglion.

Frazier stated that most of the intracranial tumours affecting the ganglion really arise from the overlying dura, and indeed this area is, according to Cushing, one of the common sites for the well-known meningiomata derived from the cells of the arachnoid. In spite, however, of its position, the ganglion seems to be well protected by the dura and its sheath, and, as emphasized by Hellstein, shows a peculiar resistance to invasion by any neoplasm. For this reason involvement by an

infiltrating glioma must be an extraordinarily rare occurrence. Two of the cases recorded by Frazier were apparently examples of tumours arising from the dura of the middle fossa, and had not only involved the Gasserian ganglion, but also had extended into the temporal lobe itself. Spiller[9] stated that one method of spread was along the floor of the middle fossa in the form of a flat growth, and that in this type uncinate symptoms were present as a rule. Extension anteriorly tended to involve the optic nerves, posteriorly the nerves in the posterior fossa usually with coincident increase of intracranial tension.

Cushing states that most of these tumours are meningiomata arising with a relatively broad base from the sphenoidal ridge and in course of time so filling the middle fossa that they press on the dura over the ganglion. He says that it is surprising how flattened the ganglion may become from this pressure without any discomfort being produced in the area of distribution of the nerve.

He states that neuralgia in these cases is inconspicuous, that it is usually overshadowed by the general signs of intracranial pressure, and that, apart from an occasional localizing value, it is often only a minor symptom. He regards such growths as readily distinguishable from the tumours which arise from the ganglion or its sheath. Elsberg,[10] in a recent article on meningiomata derived from the middle cranial fossa, also emphasizes the possibility of pressure on the ganglion by such tumours, although, like Cushing, he believes that the fifth nerve symptoms are nearly always overshadowed by others due to actual pressure on the brain above. It is possible, however, that if more careful examinations of the fifth nerve were carried out, clinical evidence of its involvement would be found in purely intracranial tumours much more commonly than is generally recognized.

3. Tumours of the Cerebello-Pontine Angle and of the Eighth Nerve.

Tumours in the region of the cerebello-pontine angle and of the eighth nerve, as pointed out by Cushing[11] in his famous monograph, arise either from the meninges or from the eighth nerve sheath in the region of the internal auditory meatus. Pathologically they show the structure of a meningeal growth in the former or a neurofibroma in the latter case and articles on their finer pathology abound in the literature.

Clinically they may produce, as in the following case, pressure effects on the main sensory root of the fifth nerve just proximal to the ganglion and so simulate somewhat primary tumours of the ganglion.

The neuralgia in these cases is as a rule relatively inconspicuous and somewhat variable, but sometimes severe spasmodic pain simulating trigeminal neuralgia and followed by sensory loss, very often with corneal inflammation, may occur. It would seem, too, that this is more likely to occur with a tumour of the angle derived from the meninges than from one of the eighth nerve. In the latter the typical syndrome described

by Cushing—tinnitus, deafness, facial weakness, diplopia, fifth nerve anæsthesia, cerebellar symptoms *et cetera*, with gradual increase of intracranial pressure—should lead to an accurate diagnosis. It is interesting to note, however, that in some of the reported cases of these tumours a futile trigeminal operation was performed.

The following case is an example of an angle tumour derived from the under surface of the *tentorium cerebelli*, near the apex of the petrous temporal bone, which extended into the cerebello-pontine recess between the eighth and fifth nerves and produced paretic effects on both.

Case II.

E.W., a female, aged 29 years, married, was admitted to hospital complaining of inability to walk for five weeks, with the provisional diagnosis of disseminated sclerosis. She stated that previous to six months before admission she regarded herself as being in normal health. At about that time she noticed attacks of giddiness, a tendency to deviate to the right when walking and occasional headaches. These symptoms gradually increased for four months, the patient becoming so ataxic that she could no longer walk without assistance. For about six weeks she had been unable to walk at all and had almost constant headaches, mainly in the occipital region.

On examination it was found that she was mentally unstable, her answers were unreliable, and, although not grossly disorientated, she did not seem to realize the gravity of her condition. She made no complaint of interference with vision or hearing, nor were there any symptoms referable to the other cranial nerves. Her poor intelligence, her euphoric state and the marked degree of mental hebetude she exhibited at times, made it difficult to obtain accurate data from examination.

Reflexes. The patient showed absent superficial abdominal reflexes; bilaterally exaggerated ankle and knee jerks with both patella and ankle clonus and a left extensor plantar response. The reflexes in the upper limbs also appeared somewhat exaggerated.

Sensation. No abnormality was detected in the appreciation of ordinary sensation in the areas supplied by the spinal nerves.

Motor Function. The gait was very ataxic, the patient needing much support, but there was no actual muscular palsy in the limbs. There was definite poor coordination of the hands and legs, with some tendency to rigidity of the lower limbs, while there also appeared to be some loss of power in all muscle groups of the lower limbs.

Cranial Nerves. The second nerve: The examination of the ocular fundi showed double papilloedema. The visual fields taken by finger test appeared fairly normal, although the patient was very difficult to examine owing to lack of cooperation.

The third, fourth and sixth nerves: Nystagmus was present on looking to the left. No definite evidence of paralysis of any ocular muscles was found.

The fifth nerve: No motor weakness was detected, but there was loss of sensation to light touch on the right side of the face, including the right half of the lip and the cornea. A mild degree of corneal ulceration on the right side was first noted by the ophthalmologist.

The seventh nerve: Weakness of the right side of the face, particularly in the lower two-thirds, was present, but emotional movements seemed normal.

The eighth nerve: There was complete loss of function on the right side and this was thought at the time to be due to cerumen. Owing to the patient's mental instability no special otological examination or Bárány tests were carried out.

No interference with the functions of the ninth, tenth and eleventh nerves was detected, but it was noted that the tongue seemed to move to the left more slowly than to the right.

Lumbar puncture revealed an increase of pressure of the cerebro-spinal fluid, but the fluid showed no increase in the number of cells, but slight increase of globulin; it gave no reaction to the Wassermann test.

Soon after admission the patient had attacks of vomiting which recurred at irregular intervals. The left lateral rectus muscle was also noticed to be paretic, while some numbness was noticed in the left side of the face. A little later the right pupil was found to be larger than the left, and the speech became thicker. A rectal injection of 50% magnesium sulphate solution had a prompt effect in relieving the headache.

Ventriculography was performed on May 19, 1931, ten cubic centimetres of air being put in the vestibule of the lateral ventricle on the right side and thirty cubic centimetres on the left side. This showed slight filling defect of the posterior horn of the lateral ventricle on the right side, suggesting some pressure from below this region. The patient, in spite of magnesium sulphate administered *per rectum* and ventricular puncture, with the removal of fifty cubic centimetres of clear fluid from the left side, became stuporose, and died with hyperthermia and rapid pulse thirty-six hours later.

Autopsy Findings. After injection of both carotids with 10% formalin solution, the brain was removed with the *dura mater* intact around it. In the region of the right cerebello-pontine recess a firm, rounded, encapsulated, non-infiltrating tumour, measuring six centimetres in its greatest diameter, was found (Figure III). Contrary to what was expected, this tumour did not originate from the eighth cranial nerve and the external meatus was not encroached upon. It arose from the under surface of the *tentorium cerebelli*, in front of the downward curve of the lateral sinus, and grew towards the pons, which was greatly indented and displaced by it. It had insinuated its way between the main posterior root of the fifth nerve on its cranial aspect and the eighth and seventh nerves on its caudal, all of these being elongated and stretched out over its surface. The position and size of the tumour explained the presence of fifth nerve anæsthesia, and there can be no doubt that nerve deafness also existed on the right side. The position also explained the symptoms of pyramidal involvement and the unilateral cerebellar manifestations.

The tumour was not adherent to the brain, had very few blood vessels running into it and could readily be separated from and lifted out of its bed in the surrounding nervous structures. Although rather large and inaccessible, it could have been dealt with successfully surgically by an intracapsular evacuation, with relief of the symptoms of pressure and great prolongation of life. It is doubtful, owing to its size and the proximity of part of its base to the lateral sinus, whether it could have been safely completely removed.

Section of the brain revealed bilateral internal hydrocephalus with some shortening of the right posterior horn of the lateral ventricle, possibly induced by upward pressure on the *tentorium cerebelli*. Microscopically this tumour conforms to one of the well-known types of meningioma, concerning which there is now such a voluminous literature.

This case illustrates some of the difficulties that may be encountered in the diagnosis of a large slowly growing tumour, even in a region where classical localizing signs usually occur, particularly when the patient is not able to co-operate. It emphasizes, too, the importance of an accurate chronological account of the sequence of the symptoms. There can be little doubt that this patient had partial or complete nerve deafness on the right side, and that this could probably have been revealed by skilled otological examination. It illustrates, too, the all important point that tumours of this angle can quietly involve the fifth

sensory root inducing anæsthesia rather than irritative neuralgic symptoms. This is typically manifested by *keratitis neurotrophica*. There is no doubt that this sign, together with the presence of signs of cerebellar and pyramidal involvement, and the obvious fact that the
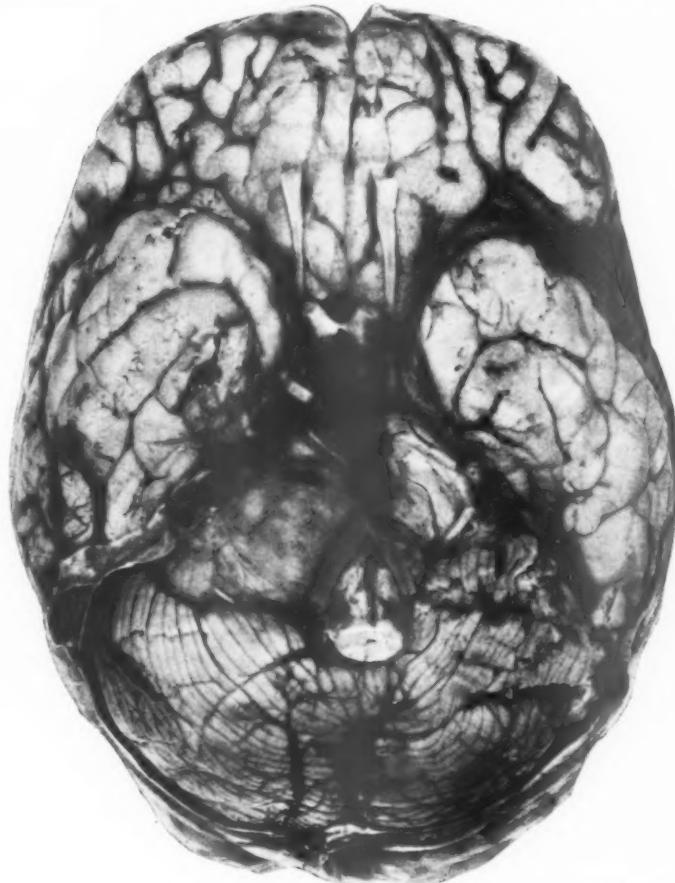

FIGURE III.   Meningioma growing from the right *tentorium cerebelli* into the cerebello-pontine recess, between the fifth and eighth cranial nerves, with gross indentation of the pons.

patient had gross increase of intracranial pressure, should have led to a correct diagnosis, without the necessity for any recourse to ventriculography, which does not as a rule help in the diagnosis of these cases, and which is always contraindicated in subtentorial lesions.

4. Tumours Originating in the Maxillary Region.

Tumours originating in the maxillary region may involve the maxillary branch of the nerve by direct extension, and so come actually to invade the ganglion itself. It would seem that the carcinomatous cells grow along the perineural lymphatics as a rule, and it is suggested that this method of extension of carcinoma is more common than is usually recognized. Peet[12] has recently reported two very instructive cases, and there seems little doubt that some cases recorded in the literature which have been regarded as primary ganglionic tumours, should have been included in this group.

Clinically in both the cases the first symptom was that of intense neuralgic pain over the distribution of the second and third division of the nerve, while both patients also complained of numbness and paræsthesia in the region of the upper lips. On examination there was an area of anæsthesia in the middle section of the face on the affected side. In one case there was also a paralysis of the muscles supplied by the motor division of the homolateral fifth nerve. No other neurological signs of importance were detected, while radiographic examination also failed to reveal any abnormality. In neither case was the carcinomatous nature of the lesion suspected; the diagnosis of tumour involving the Gasserian ganglion was, however, made, and operation for relief of the neuralgia was carried out by means of a direct attack on the ganglion.

Unlike true trigeminal neuralgia, but like the pain of primary tumours, the pain in this type is more or less constant—a deep burning ache in the face; it is not affected by eating or by pressure, and is always accompanied by an area of anæsthesia. Later, of course, owing to intracranial extension, involvement of various other cranial nerves, particularly the sixth, is common.

In the two cases referred to, the Gasserian ganglion was found at operation to be swollen, harder than normal, and to contain neoplastic tissue on incision, although there was no evidence of its extraganglionic source. As is indicated in these cases, section of the main sensory root behind the ganglion was carried out.

Section and microscopical examination revealed a diffuse infiltration of the ganglionic cells with a malignant neoplasm, the cells being arranged in small nests and masses, with a fair amount of hyaline change in the abundant stroma. The fact that the neoplasms were squamous carcinomata was revealed only when an extra ganglionic nodule was examined. In neither case was the original site of the growth suspected, and it was not until recurrence of the growth occurred with extension into the cheek and mouth respectively that the true nature of the process was recognized—one of the tumours originating in the antrum and the other in the lateral ethmoidal cells.

The peculiar structure assumed by such an epithelial tumour in this situation is remarkable, and, as mentioned above, suggests that the quasi-epithelial structure of some of the apparently primary tumours of the

ganglion that have been recorded was due to the fact that they were really extensions of a carcinoma of the antrum. It is possible, too, that such extensions may explain one of the clinical types of carcinoma of the jaw, in which severe intractable pain is the chief feature, and it is suggested that involvement of the fifth nerve by direct extension along the perineural lymphatics of its branches is rather more frequent in these and similar cases than is usually recognized. It emphasizes again the importance of very careful examination for interference with the function of the fifth nerve in all cases of severe facial pain.

5. Intracranial Extension of Naso-Pharyngeal Tumours.

As pointed out by New[13] and Woltman[14] particularly, the protean nature of the symptoms produced by the spread of what are often apparently small naso-pharyngeal growths does not seem to be widely known or appreciated. That such tumours may gradually erode the cranial base and extend into various foramina and cranial fossæ has long been known, but the clinical syndrome associated with them has only recently been emphasized. It is important to realize that these tumours, which are usually diagnosed as carcinoma or lymphosarcomata, may produce no symptoms until they have reached the cranial base, so that they may accurately simulate intracranial disease.

Site of Primary Tumour.

The primary tumour usually commences in the region of Rosenmüller's fossa, but may be anywhere in the lateral pharyngeal wall or even in the ethmoidal region. As a rule, they involve the pharyngeal opening of the Eustachian tube early, without, however, causing much nasal obstruction. Extension occurs into the pterygoid region and under the bones of the cranial base, which is quietly invaded. This is relatively easily accomplished because of the tenuity of the bone in this region and the proximity of foramina or fissures through which the growth can extend. The spheno-maxillary fissure, the walls of the orbit and the *foramen lacerum* are the common sites for this intracranial invasion. It seems that the dura is respected until comparatively late, and that involvement of the fifth and other cranial nerves is most often extradural.

Symptomatology.

With regard to the symptomatology of these tumours New may be quoted as follows:

I have gradually become impressed with the facts that: (1) malignant tumours of the naso-pharynx are much more common than has been believed, (2) the syndrome which they present is not generally known, which accounts for many patients being treated medically and surgically without the discovery of the tumour, and (3) there is a striking lack of nasal or naso-pharyngeal symptoms in many of these cases.

Such tumours, by interfering with the Eustachian tube, may produce unilateral deafness or pain in the ear, by invasion of the orbital fissure

diplopia, or by invasion of the Gasserian ganglion intractable facial neuralgia associated with anæsthesia. New, Woltman and Shelden have all recorded cases in which the diagnostic error of trigeminal neuralgia was made. The degree of trigeminal pain experienced apparently varies greatly and with the rapidity of invasion, but is present in some degree in all cases and is invariably associated with some sensory loss. Usually several cranial nerves are affected simultaneously, particularly those entering the orbital cavity and the trigeminal, but all combinations of cranial nerve palsy appear to be possible.

The existence of this group indicates the necessity for careful examination of the region of Rosenmüller's fossa by a skilled rhinologist in any case in which peculiar unexplained cranial nerve palsies, or in which there is any evidence of involvement of the fifth cranial nerve, bearing in mind that, owing to the possibility of its extrapharyngeal location, even a careful examination may reveal no abnormality or be inconclusive.

The following case, somewhat similar to several others I have seen, illustrates one type in which diagnostic errors can readily occur; and it corresponds very closely with those described by New and Woltman.

Case III.—Carcinoma of the Ethmoid with Intracranial Extension.

L.P., a male, aged fifty-eight years, was admitted to hospital with the complaint that he had found difficulty in swallowing for the past three months, so that carcinoma of the œsophagus was suspected. Six months before admission he had a slight morning cough with some blood-stained sputum. Three months later he developed a feeling that his left ear was blocked, while he had deafness and some neuralgic facial pain on the same side. His tongue was constantly furred and he felt off colour, while he often became nauseated and vomited. He had had a barium meal with investigation of the gastric function with normal findings. Radiographs of his skull taken before admission also failed to reveal any abnormality.

He had noticed the difficulty in swallowing coming on gradually about three months before admission; the food did not seem to pass beyond the tongue, and frequently regurgitated through his nose or was coughed up. This was associated with a great deal of expectoration of thick mucus. For the last month he had had numbness of the chin and his lower jaw felt powerless. He had lost a good deal of weight, but no accurate figures were obtainable.

On examination nothing abnormal was detected in the abdomen or thorax. The speech was thick and almost unintelligible, and he had great difficulty in articulation, this having become much worse during the past three weeks. He showed some left sided facial weakness, while the left eyelid was ptosed—a condition which had been present for about three weeks. The tongue was covered with thick fur and showed left sided atrophy with gross limitation of movement, being indeed almost powerless. The movement of the palate was free and apparently even.

The left eye had had the lens removed for an old injury and showed no movement; the right pupil reacted to light and accommodation, no ocular palsy being demonstrated. The left side of the face had a subjective sensation of numbness, but unfortunately no full examination of the sensory function was carried out. Left sided facial paresis was present.

The larynx apparently was not functioning well, as some of the opaque meal entered the trachea, subsequent indirect bronchoscopy revealing paralysis of the left vocal cord. Examination of the reflexes and of the rest of the nervous

system revealed nothing abnormal.   Radiography revealed no abnormality in the skull.

The left ear was deaf; details as to the exact type were not elicited.   The fauces were red and slightly indurated on the left side.

The diagnosis on admission was "possible œsophageal carcinoma", but after consultation with a physician it was thought that the condition was probably one of bulbar palsy, possibly due to syphilis, although the Wassermann test gave no reaction.

The patient had to be fed for some days by a tube, but gradually lapsed into semi-consciousness and died after a period of Cheyne-Stokes's respirations.

Autopsy. Autopsy revealed a large neoplastic mass outside the naso-pharynx extending from the level of the tongue to the base of the skull on each side, rather larger on the left.   The mucosa of the lateral wall of the pharynx seemed normal, but in the region of the ethmoid was a carcinomatous growth associated with some polypi.   This neoplastic process had invaded the dura in the region of the pituitary and the base of the skull to the left of this region, with almost complete obliteration of the anterior part of the Gasserian ganglion and the cavernous sinus on that side.

Microscopically the lesion was a carcinoma derived from transitional epithelium.

This case illustrates very well how a hidden primary carcinoma of the naso-pharynx—one which may be difficult or impossible to detect—may by its extrapharyngeal extension involve various cranial nerves and so lead to such a diagnosis as bulbar palsy.   There seems little doubt that the mass which extended to the base of the skull involved the fifth, seventh, ninth, tenth and twelfth nerves at or near their exit from the basal foramina, and that, had the possibility of this syndrome been recognized, the case would have been interpreted from this point of view and a correct diagnosis would have been made.   It illustrates several important points in the symptomatology of these neoplasms:

(*a*) Naso-pharyngeal symptoms or signs may be strangely lacking or difficult to interpret.

(*b*) Careful examination of the function of all the cranial nerves, particularly of the fifth, is essential in these cases.

(*c*) Gross extension of the neoplastic process can occur quickly along the base of the skull and give rise to protean nervous manifestations, including the so-called jugular syndrome from involvement of the nerves issuing in the region of the jugular foramen, with, as in the case recorded, simulation of a bulbar palsy.

The following case is included to illustrate the final pathological picture of a similar case, although it was impossible to obtain a clear chronological story of the symptomatology.

Case IV.

K.T., aged sixty years, had for many years been attending hospitals for a gradually developing nasal obstruction.   This had gradually developed into a classical "frog face" appearance, characteristic of certain carcinomata of the upper nasal region.   The right cheek became prominent as the condition invaded the maxillary and pterygoid regions, and this was associated with much neuralgic pain.   The orbit on the right side became involved and the eyeball dislocated with loss of sight, while various ocular palsies supervened in both eyes.   The

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right side of the face became anæsthetic and the right eyeball developed an ophthalmitis; gradual invasion of the other orbit followed and the left eye became blind. The general picture was one of an extensive malignant growth invading the base of the skull with involvement of the fifth, sixth and third cranial nerves. Death occurred from sepsis and exhaustion.

Autopsy. The facial deformity was found at autopsy to be due to a huge naso-pharyngeal tumour which apparently originated in the upper nasal passages; these passages, however, were so distorted by the growth that the true site of origin could not be determined. The growth had extended into the cheek,
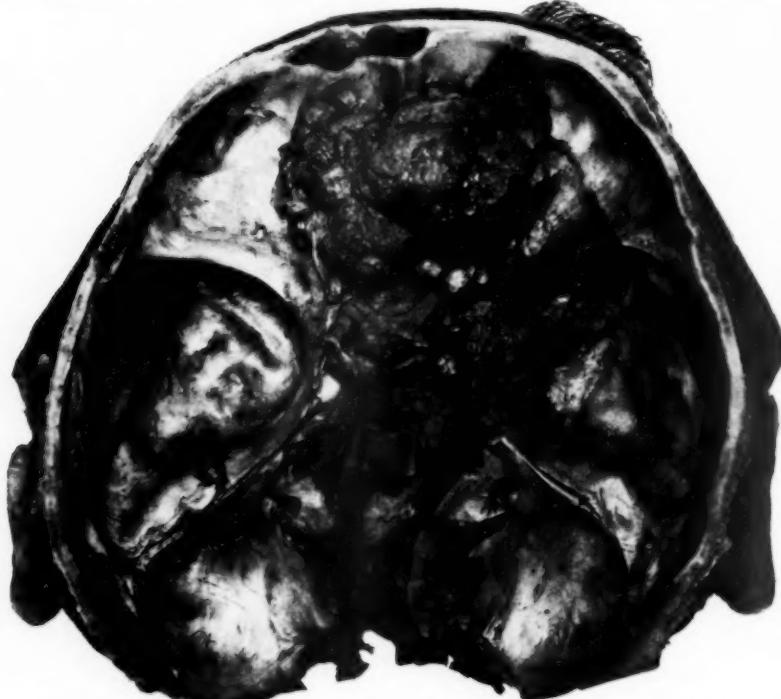

FIGURE IV. Macroscopic appearance of Case IV, showing the extensive invasion of the anterior and middle fossæ of the skull by a carcinoma of the naso-pharynx.

replacing the maxilla, and had invaded the pterygoid region, the right orbit and the base of the skull through the cribriform plate, where a very large intra-cranial mass was present. In addition, the sphenoidal fissure, the *foramen lacerum* and the *foramen ovale* were invaded, and the Gasserian ganglion had been completely destroyed (Figure IV). Such an extensive involvement of the cranial base was, of course, only the terminal picture. It explains the occurrence of exophthalmos, unilateral blindness and various cranial nerve palsies, and is in itself a remarkable object lesson of the size such a lesion can grow to and yet be compatible with life. Microscopically the tumour was a carcinoma which showed a great deal of mucoid degeneration, a not uncommon finding in carcinomata of this region.

6. Metastatic Tumours.

Involvement of the Gasserian ganglion from the growth of metastatic cells deposited there by the blood stream must be a very rare phenomenon, although it is a possibility. Much more commonly is the fifth nerve invaded by secondary carcinomatous deposits in the region of the base of the skull, most of these being in lymphatic glands. I have seen this happen in three cases recently, two being secondary to squamous carcinomata of the facial region and one to rodent ulcer of the mastoid area. In all these the region of the *foramen orale* seems to be involved with infiltration of the nerve roots and ganglion, giving rise to a syndrome similar to those just described.

The following case history illustrates some of these points:

Case V.—Simulation of Intracranial Disease by Secondary Carcinomatous Metastases in Lymphatic Glands.

J.W., a male, aged fifty-eight years, was treated with radium for a squamous carcinoma of the right ear in 1928. In February, 1931, a recurrence of the carcinoma in the right mastoid region was removed surgically, together with the lymphatic glands of the right side of the neck.

In August, 1931, he began to suffer from severe frontal headache, which was followed by the onset of diplopia, which has persisted. In October, 1931, sharp stabs of pain began in the left eye and left side of the head and neck. This pain was very severe and neuralgic in type, necessitating the constant use of analgesic drugs. It was followed by gradually increasing numbness of the left side of the face and forehead. He had an old standing right facial palsy. He had become partially deaf in both ears during the twelve months following operation.

On examination, the paresis of the fifth, sixth and seventh nerves was confirmed; there were no other neurological signs. Rhinological examination revealed a hard swelling projecting into the posterior and left side of the pharynx, which precluded an examination of the upper part of the naso-pharynx. Early in 1932 a large secondary carcinomatous gland appeared in the left deep cervical chain and was removed, the pathological report being squamous carcinoma, similar to that found both in the primary lesion and the right sided lymphatic glands.

The patient's neuralgic pain gradually became less, but the left sided facial anæsthesia became more complete. Under the influence of deep X ray therapy the progress of the disease was apparently checked and the patient is still alive, although obviously losing weight and going downhill.

This case illustrates the spread of a secondary carcinomatous process into the retropharyngeal glands, invasion of the bones at the base of the skull, mainly on the side opposite to the primary lesion, and finally involvement of the contralateral deep cervical lymphatic glands. There has been involvement of the area of the *foramen lacerum* and *foramen orale,* interference with the left Eustachian tube and no doubt further extension may cause the onset of a true jugular syndrome.

Such a contralateral spread is very interesting, and it seems to have been induced by the original lymphatic glandular removal which caused the opening up of other lymphatic channels, and so spread to the glands of the opposite side—an occurrence which, I believe, is relatively common.

SUMMARY.

A survey of the literature and a review of these cases which have been selected from a larger series, emphasize the fact that the fifth nerve trunk, ganglion or its branches can be involved by a variety of neoplasms, and that unless this fact is clearly appreciated by physicians and rhinologists, mistakes in diagnosis can and do occur very easily. Routine examination of the functions of the fifth nerve should always be carried out in all cases in which other cranial nerves are involved or in any case in which intracranial disease is suspected, while closer cooperation between the physician, neurologist and rhinologist is essential.

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CONTRACTED TOES.

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CONTRACTURE of some or all of the toes is a familiar accompaniment to many common foot deformities, for example, claw foot, *equinus*, *hallux valgus* and others. There is, however, a form which is primary or idiopathic. To the best of my knowledge, this has never been described in English or American literature, although its distinctive features and the disability to which it gives rise, mark it as a clinical entity and render it worthy of investigation and discussion. It is the object of this paper to describe as fully as possible this primary form, and to devote due attention to what may be described as the secondary variety. The paper is based on the clinical observation and operative experience of a fairly large number of cases seen during the last twelve years.

Primary contracture of the toes is not an uncommon lesion, and has provided within the period mentioned a considerable proportion of the cases of foot deformity which have been dealt with. It is definitely a deformity of young adult life, the average age of patients being between eighteen and twenty-five years. Both sexes are affected, but males have easily predominated in my series.

THE PRIMARY FORM.
Ætiology.

In a large percentage of the cases there is no obvious factor which will explain why the toes should develop this deformity, and it would appear that to argue that such a deformity may represent a biological reaction to the conditions of modern civilization, where the feet tend less and less to function as propulsive organs, may not be unreasonable.

In a certain percentage of the cases, however, a history of chronic gonorrhœa will be obtained, and it will be noted that the legs and feet of such patients are wasted to an extent appreciable by the patient and his or her friends. This relationship of wasting of legs and feet and contracted toes with the presence of chronic gonorrhœa has been definitely established in the cases of my series. The condition is always bilateral, although the subjective symptoms may be complained of in one foot only. There is no trace of *cavus* deformity, and no shortening of the *tendo Achillis*. All the toes are affected, though occasionally the great toes escape.

Symptoms.

Patients seek treatment because of pain beneath the ball of one or both feet. The pain may be distributed over the whole forefoot or be felt beneath one or more metatarsal heads. Pain is also complained of in the toes, and the latter may be the seat of corns. Pain may be referred to the tips of one or more toes, and may be associated with tingling and numbness.

Cramps of the legs and feet are frequent symptoms. The gait may be awkward, particularly in advanced cases, where in order to avoid

FIGURE IA.

pressure on the painful metatarsal heads, the weight is carried on the heels.

When examined at rest, the toes are seen to be hyperextended at the metatarso-phalangeal, and flexed at the interphalangeal joints (see Figures IA and IB). The degree of hyperextension varies. It may be readily reduced passively or by the patient's efforts, though in but few cases will the range of flexion be found to approach the normal. It may be fixed and irreducible, and the bases of the proximal phalanges may be found subluxated upon the dorsum of each corresponding metatarsal head.

The tendons of the common extensor stand out in tense relief on the dorsum of the metatarsus. The angles formed by the flexed toes are frequently capped by reddened and thickened skin or actual callosities which may be extremely tender and painful.

The skin of the sole of the forefoot is thickened either in one large plaque extending from the second to the fourth metatarsal heads or in a number of small areas beneath the individual metatarsal heads. The latter may be felt as prominences beneath the skin and atrophied soft tissues, or the soft tissues may be markedly swollen and thickened, obscuring these prominences.

In long-standing cases the superficial tissues on this aspect become over-stretched, so as to form a redundant fold which projects beneath the toes after correction has been obtained. This fold disappears in time.

Faulty foot posture is frequently found in sufferers from this condition.

THE SECONDARY FORM.

What may be described as the secondary form is found in association with the following foot conditions: claw foot, *equinus, hallux valgus,* following burns of the sole or dorsum and after injuries, following inflammatory conditions in tissues of dorsum of foot.

In this form the hallux is rarely involved, and the various toes may show varying degrees of contracture. One or two

FIGURE IB.

toes only may be affected. One foot may be entirely unaffected. In many cases no inconvenience is felt by the patient as a result of the deformity.

The association of contracted toes with *hallux valgus* is so constant in adult cases as to make it necessary to regard it as part of the general disability of the foot. In some cases the symptoms referable to this contracture overshadow those due to the *ralgus* deformity of the great toe. In all operations for the relief of *hallux valgus* the deformity of the other toes must be attended to. I have seen severe contracture associated with crippling pain follow the ordinary operation of removal of the first metatarsal head for the relief of *hallux valgus.*

Pathological Anatomy.

Since the adequate relief of this deformity must be based upon a knowledge of the structural changes which take place in the foot and

toes, it is necessary to consider what these are. The important point to remember is that all the structures dorsal to the metatarso-phalangeal joints, skin, tendons and tendon sheaths, blood vessels and nerves are shortened. Even more important than these is the shortening which takes place in the collateral ligaments of the metatarso-phalangeal joints. The overcoming of this shortening is the crucial step in the operation for relief of the deformity.

At first sight, it would appear that the shortening of the tendons of the *extensor communis digitorum* is the important muscular factor in the deformity, but I am inclined to think that this doubtful honour belongs to the *extensor brevis hallucis* and *digitorum*. True, the little toe is often markedly contracted, but close observation shows that the deformity here falls short of that of the other toes.

On the plantar surface of the forefoot attention has already been called to the overstretching and subsequent redundancy of the superficial soft tissues. The tendons of the long flexor of the toes are certainly shortened, and those of the short flexor probably so.

TREATMENT OF THE PRIMARY FORM.

The treatment of the primary form is described since it embodies the principles which are applicable to such of the secondary forms as may need correction.

Early cases may yield to conservative treatment which should always be carefully tried. Carefully carried out stretching of the contracted tissues should be done daily and should go hand in hand with active attempts to flex the metacarpo-phalangeal and extend the interphalangeal joints.

A low flat-heeled shoe, roomy in front, should be worn, and it has to be remembered that the foot lengthens as the condition improves, so that provision for that increase must be made in the shoe. A metatarsal bar should be worn constantly on the shoe, since it not only tends to relieve pain, but has a tendency to stretch the dorsum of the forefoot during weight-bearing. A footplate of papier mâché or celluloid moulded on a cast of the foot, and to be described later, should be worn always at night.

Callosities may be got rid of by the careful application of a paint containing from one-half to one drachm of salicylic acid. Shoe trees should be placed in the shoes as soon as they are discarded, in order to prevent them becoming deformed by the toes and in turn acting as a deforming factor on the toes.

In advanced cases and in those in which conservative treatment has failed, operation should be undertaken. A careful survey of the urine and of the circulation in the feet is essential, particularly in the few cases where one is called upon to deal with this deformity in elderly people.

Operation.

The following is the technique which I have evolved and practised with results which have satisfied my patients and myself.

An incision 6·75 to 7·5 centimetres (two and a half to three inches) long is made in the interval between the first and second metatarsals, slightly nearer the latter and extending distally a little beyond the level of the metatarso-phalangeal joints. No tourniquet is used. A number of veins need ligation and the plane of the *extensor longus hallucis* tendon is approached and the tendon and sheath are exposed. Search is made for the tendon of the short extensor of the great toe as it crosses medially to its insertion and it is divided. This is an essential step and must not be omitted. An incision is made along the length of the sheath of the long extensor, the tendon is lifted out and divided on each side of an artery forceps, so that a definite section of the tendon is removed. The sheath is then carefully divided across, and any of the tendinous strands which are sometimes found passing to be inserted into the first phalanx independently of the main tendon, are divided.

An incision is now made along the dorsum of the metatarsal and phalanx in the line of each, dividing the soft tissues down to the bone and joint and including about 2·5 centimetres (one inch) of the metatarsal and half that length of the phalanx.

A sharp periosteal elevator is used to separate the periosteum and the attachments of the collateral ligaments from each bone. This must be done carefully and thoroughly. When it is adequately carried out, the chief resistance to flexion of the phalanx will have been overcome and the movement can be made with ease.

The plane of the *extensor communis digitorum* tendon to the second toe is now entered, and the sheath, the tendon, and other soft tissues down to the bones, are dealt with exactly as in the case of the great toe. The tendon of the short extensor will be readily found lateral to the sheath of the communis slip once the latter has been divided; the short extensor tendon is cut through. Through the same incision the structures controlling the third toe can be similarly dealt with. It will be realized that the fewer the incisions in the skin, the less risk of scar contraction there will be during the post-operative period.

A second incision is now made between the fourth and fifth toes, and the above procedure is applied to the tendons and soft tissues of the fourth toe.

With regard to the fifth toe the procedure varies. If there is not much contraction, the joint is dealt with as above after the *extensor communis* slip and its sheath have been attended to.

Should the deformity be marked and resistant, the most satisfactory method of dealing with it is to fillet and remove the first phalanx after extending the incision already made as far as the interphalangeal joint. This is a most satisfactory method of dealing with the toe.

The next step is to deal with the contracted toes themselves. A wedge-shaped area of skin is excised over the dorsum of each inter-phalangeal joint so as to include any callosity, and sufficient of the

bone and joint surface is excised from the contiguous bones to straighten the digit and to insure ankylosis by bone in a straight position. If the distal joints are not so dealt with, it will be found that subsequently the distal phalanges become flexed at varying angles and may cause trouble. An alternative would be to divide the flexor tendons. This is strongly deprecated, as intact flexor tendons enable the toes to be used subsequently in propulsion to a gratifying extent, the power of the flexors being transmitted through the metatarso-phalangeal joints.

When the fifth toe has been filleted the treatment described is of course not applicable to this toe.

In the case of the toes the bone surfaces are approximated by one or two strong catgut sutures passed through the edges of the divided extensor expansions, and the skin is closed with three horsehair or fine "dermal" sutures. The incisions on the dorsum of the foot are closed by approximating the skin edges only with a "dermal" continuous suture. Care is taken not to wash away any blood from about the skin of the toes.

FIGURE IIA.

Splintage and After-Treatment.

In regard to splintage, from a strip of number 22 gauge aluminium and with a pair of light snips, both of which have been boiled with the instruments, long narrow splints are cut and moulded for the individual toes. They must be sufficiently long to extend from the middle of the sole to just beyond the tip or each toe. A roll of ribbon gauze 2·5 centimetres (one inch) wide is then soaked in compound tincture of benzoin and wrapped evenly and firmly about each splint so as to cover it completely and to the extent of two thicknesses of the gauze.

Each splint is then applied to its corresponding toe, and secured to it and to the foot by evenly applied turns of ribbon gauze soaked in compound tincture of benzoin. It will be found that, when mixed with a little blood, the balsam makes a hard durable cast when dry. Care is taken to mould each toe and splint so that it is quite straight, but flexed to the fullest extent possible at the metatarso-phalangeal joint.

A slab of plaster of Paris of sufficient thickness and long enough to extend from beneath the heel to well beyond the toes and of a width equal to that of the foot is now made, and moulded to each foot, so as to maintain the toes in the corrected position. Each slab is secured by a few turns of plaster of Paris bandage firmly applied about each foot and extending to the lower third of each leg from the level of the metatarsal heads (see Figures IIA and IIB). In the illustration the distal edge of a strip of adhesive marks the distal limit of this plaster.

When the plaster is set, a strip of saddler's felt which has been carefully autoclaved, of a length equal to the width of the foot at the level of the dorsum of the toes and of a width equal to the length of the toes, is sewn to the middle of a length of strong calico (see Figure III), and is applied so as to bind the toes firmly and evenly down to the plaster mould (see Figure IV).

This dressing and splintage are left undisturbed for six weeks. Very little pain is complained of, and after forty-eight hours patients feel no discomfort whatever, provided the splints, plaster and felt have been carefully applied.

At the end of this period the plaster and felt are removed, the sole plate being separated from the plaster

FIGURE IIB.

bandages and retained. After being moistened with spirit, the gauze ribbon strips are readily removed and the toes freed from the aluminium splints. The wounds should be found perfectly healed, and the sutures are removed. The phalanges will be found to be fused in toes which are now perfectly straight.

The patient is encouraged to make active attempts at flexion at the metatarso-phalangeal joints, the intact long and short flexors of the toes greatly assisting in the movement. It will be found that the elastic resistance of the tissues on the dorsum of the foot acts as an extending force against the flexor muscles, enabling them to act efficiently. Once the patient begins to walk, the resistance of the ground adds to this resistive force and further aids the flexors.

The fully dependent position is achieved slowly and gradually in order to minimize the swelling of the feet and toes, which in my experience has very seldom been more than moderate. The patient is taught to use the toes as levers in forward propulsion of the foot in walking. For two or three months a well fitted metatarsal bar is applied to the sole of the forefoot of a low heeled shoe.


FIGURE III.[1]
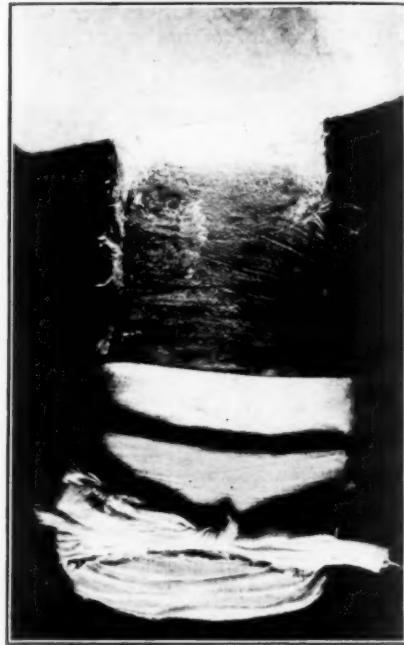
FIGURE IV.

For the six months following operation a sole plate, either the original plaster or one made of papier mâché, or celluloid to a cast of the corrected sole, is worn at night, whilst the toes are maintained in the overcorrected position by means of the felt pad and calico bandage.

This lengthy period of after-treatment is insisted upon, in order to guard against contraction of the tissues of the dorsum of the forefoot, in response to the extensive healing process which follows the radical operative procedure described.

Exactly similar treatment, or a suitable modification, in response to the local conditions, is carried out in the case of the secondary variety of contracture.

[1] In Figure III only portion of the strip of calico is included in the photograph.

THE RELATION OF PROLONGED IMMOBILIZATION AND URINARY TRACT INFECTION TO RENAL CALCULUS FORMATION.

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MUCH has been written, and much yet remains to be written, on the still controversial subject of the ætiology of urinary calculus formation, and while the exact physico-chemical conditions which ultimately determine the formation of calculi are matters of inference rather than of fact, several predisposing causes of calculus formation are definitely known to exist, and one of these, whose ætiological relationship to the process is not widely appreciated, is prolonged immobilization of the patient. Although the frequent association of calculus formation with a disease necessitating prolonged immobilization has occasionally brought forth comment,[1][2] not very many case reports exemplifying this association have been published. In many of those that have been published stress has been laid rather on the nature of the disease, usually an osteomyelitis, than on the accompanying immobilization as the primary ætiological factor.

We shall therefore report in detail several recent personal cases of this nature with a discussion on the reasons why such an association should occur. Such a discussion will necessarily entail a consideration of the mechanism of calculus formation in general, and of the exact significance of the urinary infection which is so often present. On this latter point considerable diversity of opinion still exists, so that although no experimental or clinical observations can be brought forward to furnish any conclusive evidence on the subject, it appears advisable also to place on record the rôle which we consider such infections play in the process of calculus formation.

HISTORICAL REVIEW.

In examining the case reports available, they are found to fall naturally into three groups.

(*a*) *Cases in Which the Patient was Immobilized During the Treatment of a Non-Infective Lesion.* The first case in this category was reported by Cabot[3] in 1910. Following prolonged immobilization after a severe crushing injury of the left hip, his patient passed a phosphatic

calculus, and later had a calculus removed from his left ureter. Ten years later Mayet[4] stated that Mousseaux de Vittel was the first to call attention to the occurrence of renal colic in children who underwent prolonged immobilization, and cited a patient with coxalgia, who in the course of immobilization developed multiple phosphatic renal calculi. During the discussion, Bonneau reported the case of a youth of fourteen, who fractured the bones of both legs and ten months later developed calculuria, which disappeared when he again became active. Swift-Joly[1] mentions having seen a renal calculus occur after immobilization for simple fracture of the pelvis, in the presence of a sterile urine, while Noland and Conwell,[5] in a paper based on a series of one hundred and twenty-five fractures of the pelvis, mention in passing that "in several of the severe cases the apparent tendency for formation of renal and bladder stones was very marked during the convalescent period." Wilson[6] more recently reported the occurrence of renal colic and hæmaturia in twenty-three out of one hundred and fifty men who had been treated for fracture of the femur, the symptoms occurring in each case shortly after they commenced to move about after a prolonged period of immobilization. One of these patients passed calculi and gravel, but only a very small proportion were examined radiographically. These returned normal findings.

To this group can be added a few patients in whom the calculus formation accompanied immobilization for a non-pyogenic bone infection. Mayet[4] reported two patients, both in the second decade of life, immobilized for a period of years for Pott's disease and tuberculous disease of the hip, respectively, who both developed renal calculi, in one instance bilateral. Iselin, in the course of the discussion on this paper, reported an instance of renal calculus formation following immobilization for a tuberculous knee joint.

(b) *Cases in Which Calculus Formation Accompanied Septic Disease of Bone.* Paul,[7] in 1923, reported a series of twenty patients who, following war injuries to bone and subsequent osteomyelitis, developed renal calculi. He regarded the osteomyelitis as the primary cause of their development, but practically all of these patients were subjected to prolonged immobilization. Herman, in discussing this paper, reported the case of a boy, aged eight, who developed three stones in either ureter, with a disorganized left kidney, following osteomyelitis of the right tibia and femur due to *Staphylococcus aureus.* Borman[8] has reported the case of a boy, aged nine, who developed acute osteomyelitis of the left femur, followed by fatal pyæmia. *Post mortem* there were found bilateral renal calculi of practically pure calcium phosphate, which had presumably formed during the four and a half months for which his illness had lasted. Swift-Joly[1] mentions two cases of bilateral calculi following osteomyelitis due to gunshot fracture of the femur and humerus respectively.

(c) *Cases in Which Calculus Formation Accompanied Injury or Disease of the Spinal Column.* Müller[9] in 1895 found bilateral renal calculi *post mortem* in eight out of a series of ten cases of fracture of

the spinal column. During the discussion of Mayet's paper,[4] Le Fur reported a patient who developed bilateral uric acid calculi following a gunshot wound of the spine, stating that a cystostomy was performed and that the urine was not infected; and Luys mentioned the case of a soldier who passed several phosphatic calculi following a similar injury. Swift-Joly[1] records a patient who following a fracture of the lower cervical region developed a vesical and a left renal calculus. Simon[10] in 1927 gave a medico-legal opinion that calculi might develop as a result of spinal cord injury due to fractured vertebræ.

The literature is thus not extensive. Apart from Paul's series of twenty cases and Müller's series of eight, we have been able to find only fifteen reported cases, which have mostly not been described in any great detail, and of which five were reported verbally during discussions.

PERSONAL CASES.

We shall now report six additional personal cases.

CASE I.—A male, aged forty-four years, a hairdresser, was admitted to the Royal Prince Alfred Hospital in March, 1931, suffering from acute pericarditis and pleurisy with effusion, of six days' duration. Four weeks previously he had had a vesical calculus removed by suprapubic operation in another hospital, recovery being uneventful. He was extremely ill and very dehydrated. His temperature was 38·3° C. (101° F.), his systolic blood pressure 95, and his diastolic pressure 60 millimetres of mercury. His urine, which was being secreted in small amount, contained pus and blood. His blood urea was 114 milligrammes per 100 cubic centimetres of blood.

He was transferred to the care of Dr. Mark C. Lidwill, and his condition very gradually improved. His temperature and his blood urea became normal, but his pyuria persisted. On this account he was again referred to the Department of Urology some seven weeks after his admission to hospital. During the whole of this period he had been confined to bed.

He was found to have large numbers of small bilateral renal calculi, particularly congregated in the lower calyces, with a bilateral *Bacillus coli* infection. A short course of pelvic lavage cured his infection, and he was discharged in good health after a total period of nine weeks in hospital.

Twelve months later he returned, stating that he had been passing small calculi practically ever since his discharge from hospital. Three weeks previously he had passed a comparatively large stone, with a good deal of associated pain, and had since felt perfectly well. X ray examination of his urinary tract now showed no sign of calculus.

CASE II.—A male patient, aged nineteen years, a bank clerk, was suffering from tuberculous disease of the right hip joint, which was treated by immobilization by means of a plaster spica. When first referred to the Department of Urology he had been immobilized for a period of nine months, during which time he had remained in good health.

He now complained of bilateral lumbar pain, with frequency and scalding on micturition, and his urine, previously clear, contained pus and yielded a culture of Gram-negative coliform bacilli. He was regarded as suffering from acute pyelitis. Three weeks' medical treatment only improved him slightly, and pelvic lavage was then carried out, which cured his infection. His plaster spica was then removed, and an X ray examination made of his urinary tract. This showed a staghorn calculus, not of great density, occupying the pelvis and calyces of his right kidney, while on the left side were about twelve small calculi in the pelvis, with others commencing to form casts of the upper and lower

calyces. A left pyelogram confirmed the nature of the shadows seen in the plain skiagram, and was of normal contour. His only symptom now was an occasional dull ache in the left loin. The plaster spica was reapplied and he was discharged from hospital. It was considered that when the left kidney should also form definite staghorn calculi he should not be worried to any great extent by his renal condition.

CASE III.—A male patient, aged twenty-one years, a bus conductor, had sustained seventeen months previously a compound fracture of the left tibia and fibula and a double comminuted fracture of the left femur, for which he received treatment in another hospital. Three months previously, while still in hospital, he had suddenly developed right lumbar pain, which became constant, with severe exacerbations, and which lasted for a month. Two weeks previously the pain had recurred and persisted.

On examination his right kidney was palpable and tender, and his urine contained a large quantity of pus. A skiagram showed an irregular shadow, not of great density, in the region of his right renal pelvis. Right pyelography was unsuccessful, as the injected iodide did not flow past the shadow.

He was considered to be forming calculi and a course of pelvic lavage completely relieved his symptoms, and rendered his urine free from pus and sterile on culture. He was discharged from hospital with instructions to report a month later.

Three months later he returned, complaining of severe right renal colic of a month's duration. Marked pyuria was again present, a culture of *Bacillus coli* being obtained, and a skiagram now showed two moderately large calculi in the right kidney, one forming a cast of the pelvis and the other one of the upper calyces. Pyelography was again unsuccessful.

He was kept under observation for a week, during the whole of which time his temperature was irregularly elevated, and he had periodic severe right renal pain. His left kidney being normal in every way, right nephrectomy was carried out. He made an uneventful recovery, and was discharged from hospital in excellent health three weeks later.

The pelvis of the right kidney was found to be filled with gelatinous material, apparently inspissated inflammatory products, and the kidney showed acute pyelonephritis with a moderate degree of hydronephrosis. The calculi were composed principally of calcium phosphate, but contained also calcium oxalate, urates and traces of cholesterol.

CASE IV.—A male patient, aged forty-four years, a medical practitioner, ruptured his right plantaris tendon fourteen months before being seen in consultation. A week later he developed phlebitis of the right leg and thigh. A few days later he developed a pulmonary embolism, and a few days later again a left femoral thrombosis. While still confined to bed, he developed a cough, with profuse purulent sputum, which, after lasting for three weeks, ceased five months after his initial accident. He then remained fairly well till five months later, when he developed dyspnœa on slight exertion, which persisted. A week previous to being seen he developed left renal colic, which persisted in frequent attacks.

On examination he looked ill. He was markedly tender over the left kidney, and his urine contained copious pus, yielding *Bacillus proteus* on culture.

X ray examination showed multiple opacities in the left renal area, apparently calculi in the pelvis and calyces of his left kidney.

He rapidly developed a fullness in the left loin, with a swinging temperature. A large left perinephritic abscess was evacuated, and he made an uneventful recovery. He was then discharged from hospital until such time as his general condition should sufficiently improve to permit of nephrectomy.

CASE V.—A female patient, aged twenty-five years, occupied in domestic duties, lived in Noumea. She gave a history that shortly after her last confinement,

fifteen months previously, she developed left lumbar pain, pyuria and pyrexia. She was kept in bed for twelve months, the pyrexia being ascribed to malaria, and for the whole of this time her fluid intake was restricted and she was nursing her baby. She became very weak, and lost much weight. The left renal pain and the pyuria persisted.

She was found to have a huge left-sided pyonephrosis, and a small stone in the upper calyx of the right kidney. The function of her right kidney was normal and the urine therefrom was free from infection.

Left nephrectomy was carried out, and she put on 8·5 kilograms (nineteen pounds) of weight in the next three months.

Twelve months later a skiagram showed that the right renal calculus had definitely increased in size, but it was causing her no symptoms.

Six months later she went home to France, her native country, and was lost sight of.

CASE VI.—A male patient, aged forty-two years, a compositor, was suffering from tuberculous spondylitis, and had been immobilized in a plaster spica for a period of fifteen months.

In December, 1932, he was admitted to the Royal Prince Alfred Hospital. Two weeks previously he had had a sudden attack of severe pain in the right loin, radiating to the groin, and lasting for twelve hours. Five days previously he had had a second similar attack, since when he had felt well. On each occasion there had been slight hæmaturia.

On examination there was slight pyuria. Abdominal examination revealed no abnormality.

A skiagram of the urinary tract showed no evidence of calculus. Cystoscopy showed several fragments of stone in the bladder; these were washed out through the cystoscope. The right ureteral orifice had a traumatized appearance. There was no obstruction in the right ureter. A pure growth of *Staphylococcus albus* was obtained from the urine on culture. He was discharged from hospital two days later feeling very well.

THE MECHANISM OF CALCULUS FORMATION.

Before discussing the relation of prolonged immobilization and of infection to calculus formation, it is necessary first to devote some consideration to the mechanism of calculus formation in general. Furthermore, since the most important components of urinary calculi, namely, uric acid, calcium oxalate and the earthy phosphates, are habitually excreted in amounts far greater than could be accounted for by their simple solution as such in the urine, the first problem is not to find the reason why urinary calculi are occasionally formed, but rather to explain how it comes about that despite the excessive amount of insoluble salts habitually present in the urine, their deposition is exceptional.

1. *The Retention in Solution of the Less Soluble Urinary Crystalloids.*

It has long been known that the amounts of the various less soluble urinary salts which can be extracted from clear urine are usually far greater than would dissolve in an equivalent quantity of water; that is, they are present in a state of apparent supersaturation, and in search of the explanation for this phenomenon a large amount of attention has been devoted to the urinary colloids. The composition of some of these, such as mucin, nucleic acid and glycogen, is known,

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while others have yet to be identified.   Under normal conditions they are present in an amount of 0·83 gramme per litre of urine,[11] and are considered to be derived in part from the renal epithelium.

It is an established fact that colloids in solution exert a "protective" action, tending to prevent the precipitation of crystalloids or other colloids. The apparent solubility of sparingly soluble salts is a thousand times greater in a starch solution than in water.[12]   On this account the theory has found much favour that the urinary colloids exert a similar "protective" action and prevent the precipitation of the less soluble urinary salts.

The exact mechanism by means of which this may occur, however, is not clear. Schade[13] made the suggestion, which has received some support, that the crystalloids are not in true solution, but in a state of suspension in the form of minute "droplets", in an intermediate stage between solution and precipitation, a condition which he designated "intermediate droplet stabilization", and which in other words is the identical state of affairs that constitutes a colloidal solution.   This theory offers a partial explanation for some of the properties of urine, but quite apart from the improbability that the less soluble urinary crystalloids, in the presence of the colloids, would by some mysterious mechanism go also into colloidal solution, the facts that these crystalloids are readily dialysable and that all the chemical reactions of urine point to the supposition that the majority of the urinary salts are in a state of ionization, are quite incompatible with it.

Swift-Joly[14] regards it as much more probable that the apparent supersaturation can be explained by the phenomenon of adsorption. In a colloidal solution free energy, due to surface tension, is present at the interface between the colloid particles and the solvent. It has been shown that if the colloid is a carbohydrate or a hydrocarbon, the addition of salts to the solution is followed by a decrease in this surface tension, due to the collection of molecules of the added crystalloid around the colloid particles, a process known as adsorption, the crystalloid molecules leaving the fluid and entering the solid phase, and not being in true solution. In view of the fact that most of the known urinary colloids are carbohydrates, Swift-Joly assumes that the less soluble urinary salts are adsorbed by the colloid particles. This theory offers a much more satisfactory explanation for the behaviour of these salts than does that of Schade. It is quite in keeping with the fact that they are readily dialysable, and also offers an explanation for the appearance of a crystalline precipitate on standing from a urine which was perfectly clear when passed. This may be due to "ageing", a process well known to take place in colloidal solutions, in which after the solution has stood for some time the colloid particles tend to coalesce to some extent, diminishing the total surface area available for adsorption and thus resulting in the precipitation of a portion of the more sparingly soluble salts.

Despite the many attractive features of the "colloid theory", however, it remains a theory and has never been established as a fact. On the

contrary, work carried out in recent years tends to show that the so-called "protective" action of the urinary colloids may not occur at all. Newcomb[15] subjected urine to dialysis, and found that precipitation occurred more often in the urine itself than in the outer liquid which was colloid-free. He found also that when precipitation occurred in the latter, restoration of the hydrogen-ion concentration to its original value cleared the solution, precipitation in both fluids appearing to be dependent only on the hydrogen-ion concentration and not at all on the colloids. He further found that the presence of colloids had no effect on the solubility of uric acid, phosphates and oxalates in an artificial mixture of salts resembling urine. Meyer,[16] also, after a detailed study, reached the conclusion that the precipitation of crystalloids from the urine had nothing to do with the urinary colloids, but followed the laws of precipitation from any complex solution.

Before accepting the "colloid theory" as the most likely explanation, it is necessary first to make another assumption which the facts at our disposal hardly warrant, that is, that the less soluble salts that can be isolated from the urine exist in the urine as such. To a certain extent this is true, as they can be separated by dialysis, but almost certainly not entirely. Uric acid, only very slightly soluble in water, becomes many times more soluble in a mixture of sodium dihydrogen phosphate and disodium hydrogen phosphate, the degree of solubility varying with the relative proportions of these two salts present and so with the hydrogen-ion concentration. This increased solubility, moreover, is not due to simple solution, but to chemical change, the uric acid being no longer present as such. With alterations in the hydrogen-ion concentration, the chemical process that caused the solution is reversed, and the excess of uric acid appears as a precipitate.

Very probably also calcium oxalate does not exist to any great extent in solution as such in the urine, but is largely combined with other salts to form complex products whose solubility is much greater. In this respect magnesium, a metal of very similar properties, happens to have received a good deal more attention than calcium. Magnesium oxalate, which, though more soluble than the corresponding calcium salt, still has a very low solubility, is well known to dissolve much more freely in the presence of ammonium salts, on account of the formation of complex salts. Furthermore, such a solution may be temporary only. If solutions of magnesium chloride and ammonium oxalate are mixed in appropriate quantities, the solution will remain clear for several hours and then throw down a precipitate of magnesium oxalate, exactly as some urines will throw down a crystalline deposit on standing. Quite probably the calcium oxalate in the urine is derived in a similar manner. Complex salts containing calcium oxalate are known to exist, though one containing ammonium has apparently not yet been described.

The earthy phosphates again, which are very slightly soluble indeed, are deposited only from alkaline urines. The logical inference is that until the urine becomes alkaline they have no existence as such and that until then their component radicles are in loose chemical combination

with other bodies in the form of complex salts of adequate solubility. Thus the colloid theory, attractive though it is, may quite probably not be necessary to explain the excretion in a clear urine of apparently excessive quantities of very sparingly soluble salts.

2. *The Stages of Calculus Formation.*

The formation of calculi is best considered as occurring in three stages.

(*a*) *Deposition of Crystals.* The first stage of calculus formation must be the deposition of crystals within the urinary tract, and if sufficient variation from the normal physico-chemical composition of the urine occurs, as by a markedly diminished urine excretion, excessive ingestion and excretion of calcium salts or an alteration in the hydrogen-ion concentration or a combination of any or all of these factors, precipitation will occur.

A further factor which may cause crystals to be deposited is inter-ference with the surface tension. Normally the urine and the epithelium of the urinary passages are in complete physical equilibrium, and no deposition occurs. But if the epithelium becomes ulcerated urinary salts may sometimes be deposited on the raw surface, and the same effect is consistently produced by the presence of a foreign body.

(*b*) *Retention of Crystals.* Mere deposition of crystals within the urinary tract is not sufficient to lead to calculus formation. Many individuals from time to time, and some habitually, pass urine containing quite a large amount of crystalline deposit, yet never develop calculi. An additional factor is necessary, and this is retention of some of the crystals within the urinary tract. Normally this seldom takes place. Excellent drainage is present throughout, and the crystals are passed almost as soon as they are formed. If, however, stasis is anywhere present, crystals, if deposited, have a chance to lie undisturbed and develop into calculi, and they frequently do so.

This tendency is increased if some foreign body, such as a clump of bacteria or other inflammatory product, is present to act as a nucleus on which deposition may be initiated. In the absence of this the crystals do not tend to coalesce readily, yet calculi may still develop on a nucleus formed of urinary crystalloids. Why this should be so in some patients who mostly pass a clear urine, and why calculus formation should be absent in others whose urine usually contains a deposit, drainage being apparently normal in each case, has yet to be demonstrated.

Practically all vesical calculi and many renal calculi are secondary to obvious obstruction below them. On the other hand, in the case of many renal and most ureteral calculi this is not evident. The most likely explanation of this finding is the postulation that the formation of most of these stones commenced in the lowest renal calyx. In the erect individual this is normally the only situation in the urinary tract from which drainage is not perfectly free. Owing to its anatomical conformation, crystals if deposited will sink to the bottom and remain

undisturbed for appreciable periods. It must not, of course, be forgotten that the pelvis and calyces do not form an inert receptacle out of which urine drains by gravity. Peristaltic waves commence regularly at the apices of the minor calyces and empty in turn the calyces and pelvis. The lowest calyx, however, is rather too unfavourably situated for the emptying process to be constantly and completely efficient. Moreover, if for any reason these peristaltic contractions are weak or inefficient, urine will stagnate in the lowest calyx, in contrast to the other calyces, whence it can, if need be, drain by gravity without assistance.

This reasoning is borne out by the fairly common clinical finding of stone in the lowest calyx of a pelvis whose drainage is free, but does not explain the frequent finding of calculi in such a renal pelvis or their presence in other calyces. However, calculi are frequently observed to alter their position from time to time, as a result of peristaltic activity, aided by changes in posture of the individual. Most calculi formed in the lowest calyx probably pass into the pelvis and down the ureter before their size is at all appreciable. Others in all probability constantly change their position, migrating spasmodically between pelvis and calyces till there comes a time when after a more or less prolonged period in the pelvis they are just too large to slip into a calyx. Conversely, after dropping into a calyx, either the lowest if the individual is in the erect position, or any of the others if he is recumbent, it may be impossible for the stone, after a very slight further increase in size, to get out again, so that it will continue to grow in what is now its permanent position.

For calculus formation to occur, both the preceding conditions must be fulfilled. Crystals must be deposited within the urinary tract, and mechanical conditions must be such that they can remain there and grow into calculi. As already mentioned, a person whose urinary tract is anatomically normal can pass crystals all his life without ever forming calculi, though he runs some risk of calculus formation; on the other hand, there are frequently seen hydronephroses or obstructions of the vesical neck which have been present for years without a trace of stone formation. Only some of those persons who pass crystals and some of those with obstructive lesions develop calculi. If a person is so unfortunate as to fall into both groups, calculi will develop.

In addition, calculus formation may occur in an anatomically normal renal tract in individuals who do not habitually pass crystals. In all probability such calculi originally develop in the lowest renal calyx, following precipitation of crystals with a special tendency to coalesce, which tendency is due to abnormal physico-chemical conditions as yet unexplained. In this connexion it is important to note the extreme scarcity of stone in animals such as the dog, cat and rabbit, whose urine is more concentrated than human urine, but whose pelvis and calyces are, in the normal position of the animal, provided with uniformly excellent drainage.

We do not subscribe to the opinion, often expressed by others, that an organic obstructive element accompanies every case of renal calculus. Such calculi are frequently seen where drainage, apart of course from that of the lowest calyx, is excellent, where large ureteral catheters can be passed to the pelvis without a sign of obstruction, and where prompt healing, without the slightest leakage of urine, takes place after removal of the calculus. Under such circumstances residual urine can exist nowhere but in the lowest calyx.

(c) *The Formation and Growth of Calculi.* For the formation of a calculus yet another factor is necessary, without which the crystals would remain discrete. This factor is the presence of the stone colloids which cement the crystals together to form the dense compact mass of mingled crystalloid and colloid which constitutes a urinary calculus. Each crystal as it is deposited becomes surrounded by a thin layer of adsorbed colloid, which, if the crystals remain undisturbed for a sufficient length of time, gradually cements the crystals together into a roughly spherical mass. Probably few of such masses ever attain a pathological significance, most being passed down the urinary passages and lost. They are true primary calculi, consisting entirely of normal urinary constituents, being developed on no preformed nucleus, and not showing concentric lamination.

When a certain stage of growth has been reached, such a calculus commences to irritate the walls of the cavity in which it lies, leading to an exudate of serum or blood and a consequent excess of colloid. Some of this is precipitated on to its surface, which gradually becomes smooth and comparatively non-irritating, resulting in diminution or cessation of the exudate. Steady precipitation of crystalloids meanwhile goes on, producing again a harder and more irritating surface, so that the cycle is repeated, and a calculus showing concentric lamination, due to a steady deposition of crystalloid and a regularly fluctuating deposition of colloid, is gradually developed. Such is a secondary calculus, which thus contains albuminous foreign colloid, shows concentric lamination and is developed on a preformed nucleus, which of course may be not only a primary calculus, but also a foreign body, or a clump of bacteria or other inflammatory product.

THE RELATION BETWEEN URINARY TRACT INFECTION AND CALCULUS FORMATION.

The frequent association of urinary calculi with urinary tract infections has long suggested an ætiological relationship between the two, and while some authors believe that infection plays a relatively insignificant rôle, others, such as Mayo,[17] hold that infection is the primary cause of most urinary calculi, which they believe to be produced by specific stone-forming organisms. That organisms of this type may exist is suggested by the classical experiments of Rosenow and Meisser,[18] who inoculated the pulp cavities of the teeth of a series of six dogs with streptococci isolated from the urine of a patient suffering

from nephrolithiasis; this resulted in calculus formation in the dogs, and from their urine the streptococci were again isolated. However, many calculi are encountered unaccompanied by any trace of infection, and it is hard to imagine that an infection originally responsible for the stone formation would spontaneously disappear when so many persistent infections associated with calculi are seen. Moreover, Shattock[19] showed in a series of uric acid calculi that the nucleus was practically always a primary crystalline deposit, without organisms. Again, stone formation on a foreign body does not require the presence of infection.

We therefore regard it as established beyond doubt that calculi can develop in the absence of infection. It remains to consider what influence on the process can be exerted by a urinary tract infection, and whether an infection can actually initiate stone formation.

In relation to calculus formation, the organisms infecting the urinary tract fall into two groups: those which do not split urea, and those which do.

1. *Infections by Non-Urea-Splitting Organisms.*

Infections by non-urea-splitting organisms do not directly lead to the deposition of crystals, but may do so indirectly. In a urine which is, so to speak, on the verge of throwing down a deposit, inflammatory products by causing alterations in surface tension may conceivably provide the final stimulus leading to the deposition of crystals. Eisenstadt,[20] in a series of twenty-nine infected calculi, found in every case a nucleus composed of bacteria. Given the added factor of urinary stasis, this may thus be the first stage of calculus formation, which may therefore be initiated by infection when the physico-chemical condition of the urine is already favourable. That this last mentioned factor must be essential is demonstrated by the fact that so many chronic urinary infections, associated with marked mechanical obstruction, are seen without a trace of calculus formation.

Once a stone has commenced to form, however, its rate of growth and composition become profoundly modified as a result of the infection. The constant presence in the urine of foreign albuminous colloid results in constant precipitation on to the surface of the calculus of crystalloid and colloid alike, and a higher proportion of colloid to crystalloid. This leads to the formation of a stone showing little or no concentric lamination, of rapid growth and of relatively soft consistency, of very different character from that of one formed in a sterile urine.

2. *Infections by Urea-Splitting Organisms.*

In the first place, infections by urea-splitting organisms will have exactly the same effects as already outlined. Secondly, these organisms have the property of splitting urea into ammonia and carbon dioxide, with the consequent formation of ammonium carbonate. This combines with the magnesium salts and phosphates present to form ammonium magnesium phosphate, which is insoluble, and also, by rendering the

urine alkaline, results in the precipitation of the equally insoluble earthy phosphates. Infection with such organisms can therefore be directly responsible for the deposition of crystals within the urinary tract, and can, therefore, in the presence of the additional factor of urinary stasis, directly initiate the formation of calculi whose growth may be extremely rapid.

Many organisms have the property of splitting urea. Apart from *Bacillus proteus*, a well-known member of the group, about 18% of bacilli infecting the urinary tract possess this power in greater or less degree.[21][22] The staphylococci, however, are the greatest offenders, particularly *Staphylococcus albus*, of which about 40% of strains examined by one of us[23] were shown to possess urea-splitting properties. Hellström,[24] who has also devoted much attention to this subject, similarly attaches great significance to the urea-splitting staphylococci of the albus group as an ætiological factor in the formation and recurrence after removal of urinary calculi.

In short, the rate of growth of calculi depends on two factors: firstly, the type and severity of the coexistent infection and, secondly, the amount of mechanical irritation produced on the adjacent mucous membrane.

THE RELATION OF PROLONGED IMMOBILIZATION TO CALCULUS FORMATION.

1. *In the Absence of Infection.*

The kidneys lie alongside the vertebral column with their transverse axes sloping laterally and posteriorly, so that with the patient in the dorsal decubitus the apices of the minor calyces occupy the most dependent position, while the pelvis is drained at its highest point. In these circumstances stasis must occur. In the great majority of instances no harm is done, the physical condition of the urine being such that crystals are not deposited. In an individual, however, in whom deposition of crystals occasionally occurs, and who normally would go through life passing crystals from time to time without ever developing calculi, such constant stasis in the pelvis and calyces, given sufficient time, can quite easily constitute the additional factor required to produce calculus formation. Another point of importance is that very many urines, perfectly clear when passed, will throw down a deposit on standing. It is easy to visualize such a urine, with the patient recumbent, stagnating to a sufficient degree to throw down a deposit while still in the renal pelvis. In this connexion it is of interest to note that the finding typically associated with such cases is one of numerous small calculi scattered among the minor calyces of both kidneys.

2. *In the Presence of Infection.*

A general infection will usually provide a further condition favourable to calculus formation in the form of diminished urine excretion. In most patients this is of little moment, but in a minority

this diminished fluid excretion may lead directly to deposition of crystals.

Local renal infections will influence the process of calculus formation, once commenced, exactly as already outlined, while in some cases products of inflammation may furnish the final stimulus to precipitation from a urine which was already dangerously close to throwing down a deposit. A point of importance in this connexion is the fact that renal infections are definitely more prone to develop in these bed-ridden patients, whose pelves are badly drained, than in the healthy individual, and in such patients metastatic renal infections are not uncommon.

Stress has been laid by some authors on the frequent association of renal calculi with bone infection. Some consider that metastatic infection is the cause of the calculus formation, others that it is due to excessive excretion of calcium salts due to the bone destruction. In our opinion, the immobilization to which these patients are subjected is the deciding factor, especially as so many patients with osteomyelitis are seen who never form stone.

No account has so far been given of the occurrence of unilateral, as opposed to bilateral, renal stone in these immobilized patients. The same statement of course applies to persons in good health who develop unilateral stone without apparent cause. In the absence of infection we can only postulate slight differences in the physico-chemical compositions of the urines from the two kidneys, so that while the urine from one side may remain consistently clear, that from the other may occasionally throw down a slight deposit and so initiate calculus formation. In cases in which infection is present there is nothing to prevent a patient from developing a unilateral metastatic infection which normally would not cause damage, but which with the patient in the dorsal decubitus for a prolonged period might be the final stimulus to initiate calculus formation.

COMMENT ON REPORTED CASES.

Case I is perhaps the most perfect example of the effects of immobilization yet reported. The patient formed multiple bilateral renal calculi, and once he was able to resume his normal life, with the establishment once more of satisfactory drainage, he passed all his calculi naturally and his tendency to form them disappeared. Case II is also an excellent example of the formation of bilateral stone during immobilization. In the remaining cases the stone formation was unilateral. In Case III there was a severe secondary infection, while the stones were not, comparatively speaking, very large. Here, after the calculi had reached a certain size, the severe infection caused practically complete disorganization of the kidney, with absence of urinary secretion. Colloid was present in abundance, the pelvis being full of inspissated gelatinous material, but little or no crystalloid, so preventing any further growth of the stones. Case IV is a similar

case in many respects, the picture being further complicated by the presence of perinephritic abscess. Case V is rather unusual, the patient developing a stone on one side and a pyonephrosis on the other. Here the alteration in surface tension due to the presence of the stone, the formation of which was presumably initiated during the period of immobilization, resulted in further precipitation on to its surface and continued increase in size after the patient was up and about once more. But for her illness and immobilization, she, in common with the other five cases reported, would probably never have developed a stone at all. An important point in her case is that the calculus formation was not associated with any infection of the corresponding kidney. Case VI requires no special comment.

SUMMARY.

1. The literature on the subject of prolonged immobilization in relation to renal calculus formation is reviewed and six illustrative cases are reported.

2. The mechanism of calculus formation and the influence exerted thereon by urinary tract infection and prolonged immobilization are considered.

3. Insoluble crystalloids which may appear as a urinary deposit are probably prevented from crystallizing out under normal conditions rather by the fact that in a clear urine they have very little existence as such, due to the formation of soluble complex salts, than by the "protective action" of the urinary colloids.

4. The first stage in the formation of a calculus is the deposition of crystals within the urinary passages.

5. For a calculus to develop, mechanical conditions must be such that this deposit can be retained in the urinary tract for an adequate period.

6. Under normal conditions, such stasis may occur only in the lowest renal calyx, while if urinary obstruction exists it may occur anywhere in the urinary tract.

7. A urinary infection leads to accelerated growth of calculi, but cannot alone be responsible for their formation.

8. In the presence of stasis a urea-splitting infection may by the deposition of crystals initiate calculus formation, while a non-urea-splitting infection, by providing inflammatory products on which the primary deposition of crystals may occur, may, if the urine is already dangerously close to throwing down a deposit, thus indirectly initiate calculus formation.

9. Prolonged immobilization, by interfering with the drainage from the pelvis and calyces as a result of the position occupied by the kidneys, may provide sufficient time for the deposition of crystals which would otherwise not have been deposited till the urine had been voided, and cause these crystals to be retained, thus leading to calculus formation which would otherwise never have developed.

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FOREIGN BODIES IN THE ŒSOPHAGUS AND BRONCHI.

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IN this series of foreign bodies in the food and air passages, the record of the Royal Prince Alfred Hospital, 1926 to 1932, shows that œsophagoscopy was performed in 75 cases, and examination of the air passages in 19. In all these cases the foreign bodies had been definitely located by X rays or physical signs. Many hundred routine examinations of the œsophagus and air passages for various other affections are not included in this series.

All patients coming to the hospital with a history of having swallowed or inhaled a foreign body are admitted and examined by X rays, and if any urgent symptoms are present, they are seen immediately by one of the honorary surgeons attached to the department. No examination is permitted by the casualty surgeon.

The results of œsophagoscopy were very satisfactory, and the foreign body was removed in 63 cases (Table I). It was seen and pushed into the stomach in three cases without any further trouble resulting, and in two cases was vomited during anæsthesia preparatory to the œsophagoscopy. In the other seven cases the foreign body was not found in the œsophagus, having passed into the stomach before extraction was attempted. All 75 patients were treated without mortality.

The cases of foreign bodies in the air passages were much less satisfactory (Table II), as out of 19 cases four were fatal and three patients were unrelieved, as the foreign body could neither be found nor removed. In the fatal cases two patients were aged eight months, one was aged sixteen months and one fifteen years. In all these cases associated bronchopneumonia or abscess formation was present when the patient was admitted to hospital. For the two youngest patients no instruments were available by which the foreign bodies could be reached. Since encountering these cases I have had made three special tubes, with the necessary extracting forceps, suitable for use in infants under twelve months. These are beautiful examples of the instrument maker's craft, being only three millimetres in diameter, and are made to be used through a tracheotomy wound. They were made by Mayer and Phelps of London.

Chevalier Jackson has written so fully on the management of foreign bodies generally that no attempt is made here to explain our technique.

It follows closely that of Brunig and Kahler, except that we have designed a special œsophagoscope in which a sucker is incorporated in the tube, the necessity for any separate sucker tube being thus obviated.

TABLE I—FOREIGN BODIES IN ŒSOPHAGUS: ROYAL PRINCE ALFRED HOSPITAL, 1926 TO 1932.

Œsophagoscopy performed in 75 cases (see below).
Sex.—Male: 31.   Female: 44.
Age Incidence.   14 months to 80 years.

1 to 5 years	8 cases
6 to 10 years	6 cases
11 to 20 years	1 case
21 to 30 years	13 cases
31 to 40 years	16 cases
41 to 50 years	12 cases
51 to 60 years	13 cases
61 to 70 years	4 cases
71 to 80 years	2 cases

Type of Foreign Bodies—
(1) Coins .. .. 9 cases
(2) Meat bone or cartilage .. .. 43 cases
(3) Fish bones .. .. 9 cases
(4) Dentures .. .. 8 cases
(5) Wood (resembled a match) .. .. 1 case
(6) Buttons .. .. 2 cases
(7) Metallic bodies—
        (*a*) Tin whistle .. .. 1 case
        (*b*) Drawing pin .. .. 1 case
        (*c*) Piece of brass .. .. 1 case

Site of Foreign Bodies (indicated in 57 cases)—
(1) Entrance of œsophagus .. .. 12 cases
(2) Cervical portion of œsophagus .. .. 19 cases
(3) Thoracis .. .. 19 cases
(4) Region of cardiac orifice .. .. 7 cases

Results of Œsophagoscopy (75 cases)—
(1) Foreign body removed .. .. 63 cases
(2) Foreign body not found in œsophagus .. .. 7 cases
        (*a*) Foreign body passed *per rectum* .. .. 1 case
        (*b*) Tear of posterior wall of œsophagus
                four inches below cricoid noted .. .. 1 case
        (*c*) Area of ulceration noted in cervical
                portion of œsophagus .. .. 1 case
(3) Foreign body seen and pushed down into stomach .. 3 cases
        (Foreign body vomited up on return to ward in 2 of these cases.)
(4) Foreign body vomited up during anæsthetic preparatory
        to œsophagoscopy .. .. 2 cases

Anæsthesia—
(1) Local .. .. 4 cases
(2) General .. .. 71 cases

The vacuum is provided by an electrically driven sucker, and in the new operating block at the Royal Prince Alfred Hospital this vacuum system is installed in each theatre.   It is interesting to recall that the idea of

this electrically driven sucker originated in our department in 1917 during the treatment of Miss Alma M.

This patient, aged thirty years, had swallowed an upper tooth plate some ten years previously. The plate had ulcerated through the posterior wall of the

TABLE II.—FOREIGN BODIES IN AIR PASSAGES: ROYAL PRINCE ALFRED HOSPITAL, 1926 TO 1932.

Total number	.. ..	19 cases
Site—		
Right lung	.. ..	10 cases
Left lung	.. ..	5 cases
Trachea	.. ..	1 case
Not known	.. ..	3 cases
Types of Foreign Body—		
Tooth	.. ..	2 cases
Peanut	.. ..	4 cases
Metallic *et cetera*	.. ..	10 cases
(*a*) Screws	.. .. 3 cases	
(*b*) Nails	.. .. 2 cases	
(*c*) Tacks	.. .. 2 cases	
(*d*) Cartridge, 0·22 long	.. .. 1 case	
(*e*) Stone or coal	.. .. 1 case	
(*f*) Pin	.. .. 1 case	
Piece of rubber	.. ..	1 case
Fish bone	.. ..	1 case
Leaf	.. ..	1 case
Sex—		
Male	.. ..	6 cases
Female	.. ..	13 cases
Bronchoscopy. Carried out in 19 cases.		
Results—		
Foreign body coughed up	.. ..	1 case
Patient cured	.. ..	10 cases
Patient relieved	.. ..	1 case
Patient unrelieved (no further record)	.. .. ..	3 cases
Deaths	.. ..	4 cases
Age Incidence. From 8 months to 39 years.		
Under 12 months	.. ..	2 cases
1 to 2 years	.. ..	4 cases
2 to 5 years	.. ..	4 cases
6 to 10 years	.. ..	1 case
11 to 20 years	.. ..	5 cases
21 to 30 years	.. ..	2 cases
31 to 40 years	.. ..	1 case
Anæsthesia—		
(1) Local	.. ..	3 cases
(2) General	.. ..	16 cases

gullet at the level of the fourth and fifth dorsal vertebræ, a fistula about two inches long leading from this cavity into the gullet at the level of the third dorsal vertebra. The fistula was gradually dilated until forceps could be introduced through it, and an attempt was made to cut the plate. Owing to the soft and toughened condition of the vulcanite, this was found to be impossible, and

finally a long galvanocautery had to be devised to cut the plate. The end of this cautery was shaped like a violin bow with the wire guarded on one side by an ivory plate to prevent burning the surrounding tissues.

The wire was applied to the plate, but the resultant fumes immediately obscured all view of the field of operation. We then devised an electrically driven sucker to remove the smoke, and this enabled us successfully to cut the plate into several small pieces, which were readily removed. Since swallowing the plate, this unfortunate girl had existed only by means of a gastrostomy tube, and at the time of its removal weighed less than 44·1 kilograms (seven stone). She rapidly put on weight up to 69·3 kilograms (11 stone) and has never suffered any further inconvenience. This case was reported briefly in 1920 at the eleventh session of the Australasian Medical Congress.
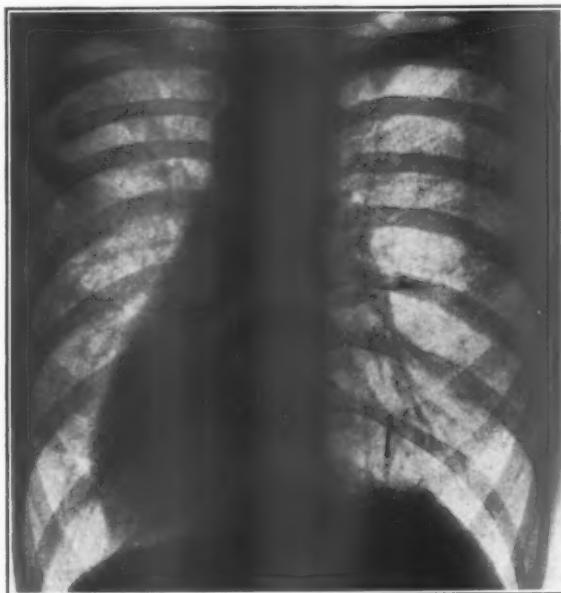
FIGURE I.

As a routine, ether given intratracheally, with a preliminary injection of atropine, is given in all these cases, except when it is contraindicated. In the absence of a permanent team, which is impracticable in a general hospital, it has been found impossible to do these removals under local or without any anæsthesia, and the satisfactory point emerges that in no fatal case can the intratracheal administration of ether be considered as a causative factor.

The lack of suitable forceps was directly responsible in a few cases for failure to remove the foreign body. These faults have now been largely rectified, and the hospital is reasonably well equipped with

instruments. It is still sometimes necessary, however, for surgeons to bring up their own private sets to supplement any deficiency that may arise.

The following two cases of special interest are recorded. The first illustrates the difficulty of dealing with an open safety pin at the base of the right lung in a tall patient. The second is a case of a wilfully concealed foreign body in the left lower bronchus of a child of five and a half years.

FIGURE II.

Mrs. S., aged thirty-six years, over 180 centimetres (six feet) in height, with a correspondingly long thorax, inhaled a small gilt safety pin 2·5 centimetres (one inch) in length. When she consulted her local doctor, he had an immediate X ray examination made. The open pin was detected lying in the right bronchus about 2·5 centimetres (one inch) below the bifurcation. She was at once sent to Sydney by motor car, a distance of about two hundred miles.

When she was examined with the bronchoscope on arrival no trace of the pin could be discovered. No further search was made on this occasion. The patient was examined again by X rays next day, when the pin was found to have descended 5·0 centimetres (two inches) during the journey, and was now lying at the level of the tenth thoracic vertebra (Figures I and II). The

impossibility of reaching the foreign body through the mouth, owing to the length of this patient's thorax, was realized, and a low tracheotomy was performed under "Avertin" anæsthesia. Several unsuccessful attempts were made to close the pin by passing a loop of very fine wire beyond the pin and drawing it back over it. Finally success was attained by pushing the head of the pin into a lateral bronchiole and performing version; the pin was then quite easily removed with the point trailing. Recovery was rapid and uneventful.

The lesson to be learnt from this case is that accurate localization of depth of the foreign body is necessary. The probability of this pin having gone deeper during the journey should have been realized and

FIGURE III.

a second X ray examination should have been made before any attempt at removal was made. This would have obviated the first examination and the necessity of a low tracheotomy in order to reach the foreign body would have been apparent.

Master K.C., aged five and a half years, developed right lobar pneumonia followed by a very long convalescence. Two months afterwards he had a similar attack with some effusion at the right base. His chest was needled and fluid withdrawn. As the child did not improve, radiography of the chest was carried out, and a metallic foreign body was detected in the left bronchus about 5·0 centimetres (two inches) below the bifurcation. The child denied all knowledge of the foreign body. When fit to travel the patient was sent to Sydney. Examination revealed a very wasted, delicate child with marked bronchitic sounds on both sides.

The radiographers reported that there was a large opaque foreign body lying in the lower left bronchus about 5·0 centimetres (two inches) below the

G

bifurcation.   There was consolidation at both bases, the appearance suggesting a septic pneumonitis, probably with bronchiectasis, on the left side (Figure III). The child was kept in bed for three weeks until his condition allowed an attempt to remove the foreign body.

Under full rectal "Avertin" anæsthesia, a tracheotomy was performed and a mass of granulations was found low down in the left bronchus.   These were carefully picked away and the bleeding was controlled with adrenaline swabs. It was then found that the foreign body had very jagged upper edges, and these caused great trouble in removal owing to their catching in the bronchial rings. It was coaxed up into the trachea, from which it was quite easily removed.

The child made an uneventful recovery, and the tracheotomy wound was allowed to close on the second day.

When shown the foreign body, the child first denied all knowledge of it, but finally admitted to having played with it in church, and to swallowing it when trying to make it whistle. He explained that he did not tell his father, who was with him at the time, as he thought he would get smacked.

The lesson in this case is the supreme importance of examining with X rays all chests which do not clear up normally after any infection.

Surgical Technique.

A SIMPLE BUT RAPID PERINEORRHAPHY.

By F. A. MAGUIRE,

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ONE of the common conditions that the surgeon is called on to deal with in the pelvis is some degree of relaxation of the pelvic floor, due usually to obstetrical damage. The operation which is described here is designed as a quick but simple repair based on the anatomy of the parts. It will correct the lesser grades of relaxation of the pelvic floor; but with modifications it can be applied to almost any type of relaxed pelvic outlet.

First Step. A point is selected at each side of the vaginal orifice immediately behind the posterior end of the *labium minus.* At this point the hook of a Gelpi
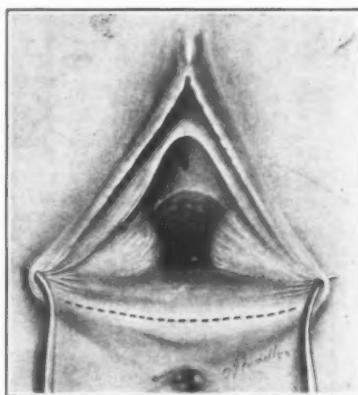
FIGURE I.

FIGURE II.

perineal retractor is inserted through the skin and mucous membrane. By separating the points the edge of the perineum is put on the stretch and is made a straight line. About 2·5 centimetres (one inch) deep to this line the ridge of the *levatores ani* muscles can be seen on either side of the vagina. The degree of separation and distortion of the *levatores ani* muscles will vary with the amount of damage that has been done to the parts. Usually the muscle on one side is torn back to a greater extent than on the other. As a result of this a furrow or groove appears on one side or other of the posterior vaginal wall (Figure I).

Second Step. An incision is made from one side to the other on the stretched perineal margin about three millimetres behind the muco-cutaneous junction. The edges are picked up by suitable forceps, such as Moynihan's bile duct forceps. That on the posterior edge takes a bite that will include the external *sphincter ani.* By putting traction on this forcep the *levatores ani* muscles can be brought into prominence (Figure II).
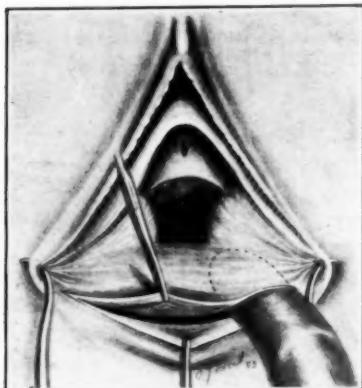
Third Step. The incision is deepened at the outer end and just medial to the point where the perineal retractor is inserted into the lateral wall. It is carried in with the knife blade until it is about eight millimetres (a third of an inch) in depth, and lies behind the vaginal wall at the junction of the lateral and posterior walls of the vagina. The point of a Mayo curved scissors is then inserted and gently pushed up behind the junction of the posterior and lateral vaginal walls until it reaches the level of the ridge caused by the *levator ani.* The path of the scissors is really at the postero-lateral angle of the vagina. Here it can be carried up freely without fear of damaging the wall of the rectum which lies behind the posterior wall of the

FIGURE III.

vagina. The blades of the scissors are opened two or three times and closed again. They are then closed and withdrawn, and they leave a track into which the index finger can be passed. The index finger is thrust in and the opening is widened.

FIGURE IV.
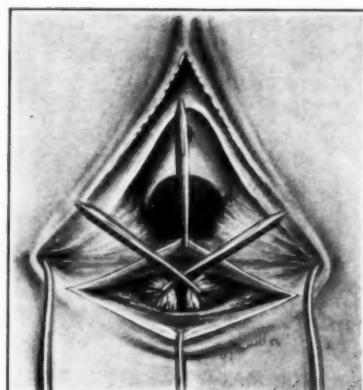
FIGURE V.

With the finger turned downwards and outwards, the ridge of the *levator ani* can be felt on the ball of the finger. It can be traced from the lateral wall of the vagina back to the posterior part of the perineal body in the vicinity of the anal canal. It is easier to do this if the forceps on the posterior edge of the

incision is drawn towards the operator so as to render the muscle taut.   This
manœuvre is repeated on the other side (Figure III).

Fourth Step.   The forceps on the anterior edge of the perineal incision is
now lifted up and the vaginal wall is dissected back by the knife or scissors
for about 1·25 centimetres (half an inch).   Then it can be rolled back with gauze
over the gloved finger.   This reflection is carried up for about 5·0 centimetres (two
inches) until the *levatores ani* muscles are exposed on either side right out to the
lateral wall of the vagina.   There is very little bleeding at this stage, but one or
two veins may have to be picked up and tied (Figure IV).

Fifth Step.   The antero-posterior margins of the wound are widely separated.
The *levator ani* on either side is picked up by bile-duct forceps and lifted up out
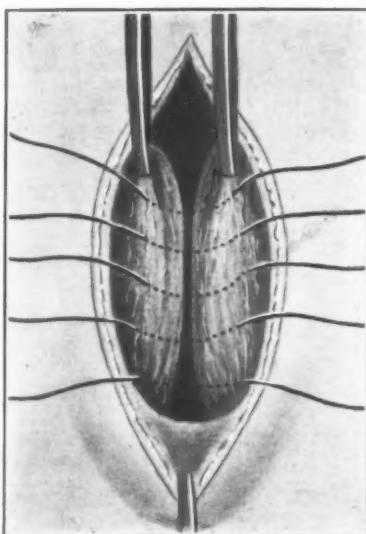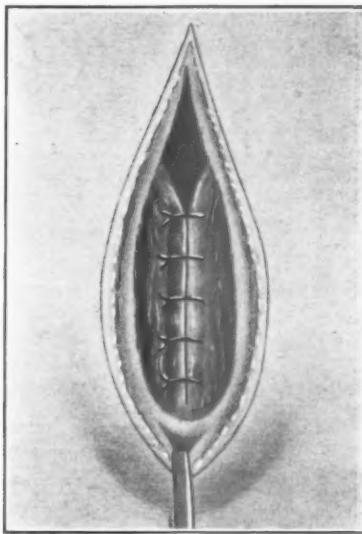
FIGURE VIA.   FIGURE VIB.

of the lateral part of the wound.   They stand out as thick and as wide as the
margin of one's index finger (Figure V).

Sixth Step.   A series of interrupted catgut sutures of number 4 plain catgut
is passed through the two *levator ani* muscles.   Five stitches usually suffice.
The uppermost stitch includes the deeper part of the vaginal wall.   The Gelpi
perineal retractor is now taken out and the stitches are tied.   This brings the
levatores ani muscles into apposition in the mid-line.   The uppermost stitch
includes the deep layer of the posterior vaginal wall and obliterates dead space
(Figures VIA to VIE).

Seventh Step.   A deep stitch is now passed through the triangular ligament
(or uro-genital diaphragm) on either side immediately behind the vaginal wall.
This stitch also includes the vaginal wall.   When this stitch is tied the tension
can be seen to be taken up right out to the *tuber ischii* on either side.   When
this is done the passive or membranous supports of the perineal body are restored
to their natural condition.   It is through them that the perineal body receives its

attachment to the bony walls of the pelvis. Thus they help to support the muscles which are the active part of the pelvic floor.

At least three sutures are inserted to restore the triangular ligament in the mid-line.

Closure. In the majority of cases it is unnecessary to remove a portion of the vaginal wall. If this is done, not infrequently a bowstring edge with a tender scar is left on the perineal margin, which later causes dyspareunia. By preserving all the vaginal mucosa a soft, smooth vaginal orifice is left which causes the patient no pain when the parts have healed. A purse-string suture of number 2 chromicized gut is now inserted to restore the posterior vaginal margin. This is tied when it is first passed and then the purse-string is run round the edge of the vaginal mucosa and drawn firmly. Then it is carried two or three times
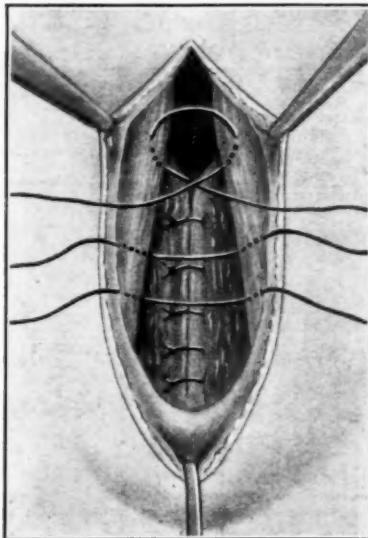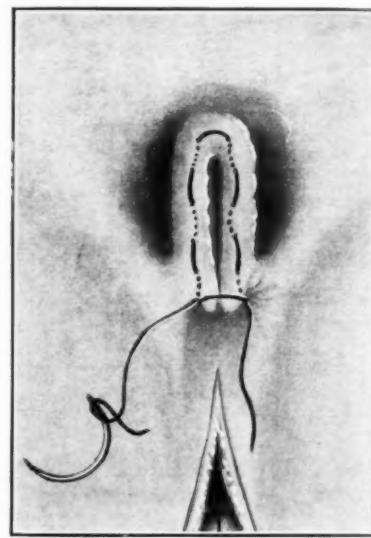
FIGURE VIC.   FIGURE VID.

over the edge of the vaginal mucosa. When the stitch is finally tied, it bunches the vaginal mucosa in a soft, smooth ridge at the vaginal orifice. It preserves the normal nerve endings and later gives a painless introitus. A subcutaneous suture of plain number 2 catgut is now run along from the anterior to the posterior edges of the skin surface. Interrupted chromicized stitches of number 2 gut complete the closure of the skin wound. Five stitches usually suffice.

Dressing. The dressing that I have used in recent months which has proved most satisfactory has been friar's balsam, which is spread over the whole of the perineal surface from the vaginal orifice to the anal margin. Iodoform powder is then dusted over the surface, leaving it dry and clean. When the operation is completed, on separating the labia, the urethral orifice is seen just clear of the vaginal margin, as it is in the nulliparous vulva. The vagina passes upwards and backwards at its normal axis and is strongly supported by the restored perineal body.

The final result gives a strong posterior vaginal wall and perineal body. The vagina should easily admit two fingers. It is of advantage to pack the vagina

firmly with gauze after the operation is finished to give counter-pressure. This gauze is left in position for twenty-four hours.

It is a great advantage to pass a catheter and stitch it in the urethra for three or four days. This means that the parts are entirely undisturbed while the catheter is in position. By the time the catheter comes out or is taken out, the patient has regained normal control of the bladder and there is no
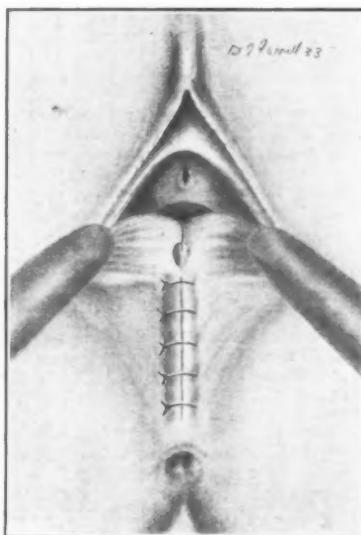

FIGURE VIE.
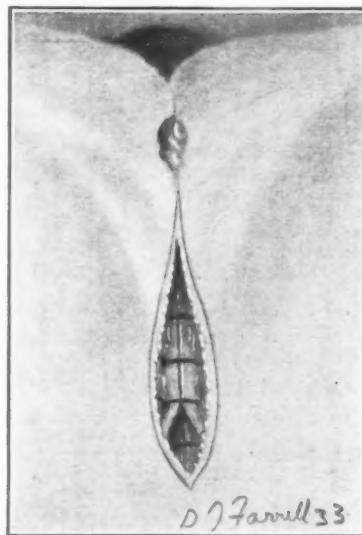
FIGURE VII.

necessity to disturb the parts at all. Nurses who have looked after these patients with the catheter stitched in, all agree that it is a very great comfort to the patient. A little weak Condy's solution is run into the bladder daily while the catheter is in position. The bowels are left undisturbed for four days.

This operation can be done in about ten minutes and causes no shock. It is a very useful operation for a rapid restoration of a relaxed pelvic floor.

DRAINAGE.

By T. FARRANRIDGE,
Honorary Assistant Surgeon, Royal Prince Alfred Hospital.

SURGICAL drainage is a very important part of technique, yet there is probably no subject in which opinion and practice are more varied and contradictory. Analysis of the records of the Royal Prince Alfred Hospital discloses a wide divergence in the selection of pathological states deemed suitable for drainage, and an equally confusing account of the results of this procedure. Once again there is no clear indicator of the relative severity and extent of the lesions, so that any tabulation of recorded facts would appear to be unreliable. Therefore statistical methods have been abandoned in this discussion, and instead the impressions arising from observation and experience have been substituted. The practice of the Royal Prince Alfred Hospital surgeons is the basis of this article.

Classification.

Drainage in surgery is a very comprehensive subject, and it must not be thought that a consideration of the mere insertion of a drainage tube disposes of the matter. Nature has arranged many excellent examples of drainage, as, for instance, the innumerable ducts and canals that lead away from secreting and storage viscera. Some of these channels open into larger internal tracts, and others open on to the surface direct. Hence we may adopt a nomenclature already in common use in surgery, that of "open" or external, and "closed" or internal, in reference to artificial drainage. A lesson may also be learned from Nature that natural tracts may be utilized for drainage purposes, as is so well exemplified in the case of genital tract, urinary tract, and alimentary canal conditions.

Surgical drainage may be typed as continuous or intermittent, as well as artificial or natural. It is not proposed to give theoretical descriptions of the principles of drainage, but rather to select common surgical conditions and to detail what is actually performed at this hospital.

Drainage of the Pelvis.
Pelvic Abscess.

Once pus has become localized in the pouch of Douglas, and has been given time to form superior limitations, the inflammatory products should be evacuated. Unquestionably the best and most efficient method is by the operation of posterior colpotomy. The technique used is standardized, but a warning should be given about the great danger of evacuating the pus too rapidly, and especially against the practice of assisting the flow of pus by means of suprapubic pressure. Both these procedures have been found to cause a tearing away of the upper boundaries of the abscess, which disaster has led to a fatal general peritonitis. Digital exploration of the cavity of the abscess by way of the colpotomy opening should be engaged in with the greatest care and gentleness. Opinion varies as to whether a rubber drain anchored by a suture to the vulva should be introduced into the colpotomy aperture, or whether a gauze wick should be left *in situ* to be gradually shortened during the next few days. Both tube and gauze may be removed in about six days. Either method is efficient, but a watch should be exercised for signs of reaccumulation of pus, upon which event a finger should be passed through the opening so as to dilate it. All discharge usually ceases in about a fortnight.

Drainage of a pelvic abscess by the suprapubic route is a dangerous and unsatisfactory method in comparison with drainage by the vaginal route, though

it may be the only available way as, for instance, in the case of an appendiceal pelvic abscess in the male. A large calibre firm rubber tube is introduced by a stab wound in the middle line about one inch above the *symphysis pubis*, care being taken that the urinary bladder is not distended. This tube passes right down into the recto-vesical pouch and is secured by a silkworm gut suture to the skin. The tube should not be allowed to rest upon inflamed structures, such as intestine or blood vessels, for more than a day or two, since pressure necrosis results from continued contact. Therefore the tube must be shortened about an inch every couple of days, and removed altogether within ten days. Persistent fistulæ sometimes arise from this route of drainage, and necessitate further operation at a later date.

Pelvic Peritonitis.

The problem of the acute inflammatory pelvis from the point of view of drainage is a very interesting one. Firstly, there is the case in which it is clear that the condition is an acute pelvic peritonitis arising from acute salpingitis. There does not seem to be any question really that the best treatment is conservative watchfulness with medication by morphine, aided after a few days by hot vaginal douches. The wise surgeon will refrain from performing a section, or, if he has mistakenly done so, he should close the abdomen again without disturbing the pelvis in any way. The results of this "neglectful" treatment are better than those of radical removal of the pelvic adnexa while they are acutely inflamed. Secondly, there is the case in which section and pelvic exploration disclose adhesions, pus-tubes, or tubo-ovarian abscess, upon removal of which some pus has been spilt into the pouch of Douglas. Some surgeons content themselves with a thorough mopping up of the pus and *débris* and then closing the abdomen without drainage; these cases usually do remarkably well. Other surgeons think that the pelvis should be drained for a few days, and if this is done an immediate colpotomy, carried out while the abdomen is still open, is the best procedure. The latter method is the policy of extreme caution, and, though often quite unnecessary, cannot do any harm, and may be of the greatest value in promoting the escape of inflammatory products.

Pelvic Hæmorrhage.

The steady persistent oozing so often found from widespread raw surfaces that are inseparable from the freeing of pelvic adhesions and adherent tubo-ovarian masses often occasions great perplexity in the surgeon as to whether he should close the abdomen with or without drainage and packing. The decision is a matter of experience and judgement. Intraabdominal pressure will arrest the bleeding in the majority of cases, but if drainage and gauze packing are decided upon, the use of a posterior colpotomy route is the better, though the lower end of the section incision may be used. Such gauze should not be removed before four days, as it comes out much more easily at this time and does not occasion bleeding by being disengaged from freshly thrombosed areas. An old pelvic hæmatocele may be drained by the vaginal route. The hæmatocele of a ruptured ectopic pregnancy must not be drained.

Drainage of the Peritoneum.

General Peritonitis.

It is well known that the importance and virulence of a general peritonitis depend upon the nature of the irritant and the advent of infection. The problem of drainage depends upon the causal factor.

Ruptured Duodenal or Gastric Ulcer. If the patient has come for operation within the first six hours and the extravasate is mainly gastric juice, many of our surgeons content themselves with simply mopping up the fluids in the peritoneal cavity and closing the abdomen without drainage. If there are large quantities of fluid, especially gravitated into the pelvis, the usual practice is to insert a large bore rubber tube deep down into the recto-vesical pouch by way of a suprapubic stab wound. This tube is shortened day by day and is removed in about a week. In all early and late cases in which peritoneal free fluid is

turbid either as the result of foodstuffs, infection or fibrin, the abdomen is drained by a suprapubic tube, and often further tubes leading down to the ulcer area itself and to the right para-colic gutter. In those desperate cases in which the oversewing of the ulcer is unsatisfactory or impossible, a drainage tube is inserted through the exploratory incision down to the ulcer. It will be found possible to remove the tube altogether in about an average of eight to ten days. The policy of safety seems to be to drain either locally or by the pelvic route all cases of ruptured gastric and duodenal ulcers.

Ruptured Small Intestine. In all cases of perforation of the small intestine by either trauma or pathological causes in which any appreciable interval has ensued between the event and the surgical repair of the rupture, the peritoneal cavity is almost certain to have been contaminated and potentially infected. It is wise to drain the peritoneal cavity, but the site of drainage is rather a gamble. Probably a suprapubic drain is the most generally useful. Serious consideration must be given to the advisability of arranging for the drainage of the natural passengers of the tract, so as to secure healing of the repaired intestine with as little disturbance from movement and contamination as possible. An enterostomy of a temporary type may be carried out, though experience shows that this is very rarely necessary. If the rupture is due to a serious pathological cause, the intestine may well be drained by means of an entero-enterostomy, the affected area being thereby short-circuited. In cases in which the small intestine has been accidentally opened at operation, simple closure of the bowel and closure of the abdomen without drainage may quite confidently be done.

Perforation of the Large Intestine. It is apparently essential in all cases of rupture of the large bowel to supply liberal drainage from the site of rupture and from the pelvis if any of the contents have gravitated thereto. In spite of drainage a large proportion of these cases end fatally. If an anastomosis involving the large bowel has been carried out, the performance of a caecostomy, proximal colostomy or enterostomy, as the case may suggest for the purpose of diverting the passengers and providing a rent for the escape of flatus, is a very wise precaution. Healing is greatly accelerated, and leakage into the peritoneal cavity is considerably reduced as a complication.

Perforation of the Appendix. Perforation of the appendix is probably easily the most common rupture of the intestinal tract. The occurrence demands urgent intervention. It is considered essential to remove the appendix, as in these types of appendiceal inflammation there are no friendly adhesions localizing the trouble. The general peritoneal cavity is widely infected at the time of burst, or will inevitably be infected within a very few hours. The removal of the appendix eliminates the source of infection, thereby giving the peritoneum a chance of dealing with its own emergency. However one may help by removing fluid, if it be obviously contaminated, drainage of the locality and the pelvis is advisable. The results of drainage of the peritoneal cavity after the rupture of an appendix are very mixed. If the invading organism is the *Bacillus coli communis,* the outlook is fairly favourable. The tube and the subsequent sinus will discharge very foul fæculent pus for a period lasting up to several weeks, but in most cases this ultimately ceases. This discharge is not to be confused with fæcal matter coming from a real fistula arising in the caecum. A true fistula is found to be rather rare. If the organism causing the peritonitis is the streptococcus, all the drainage in the world usually fails to arrest the condition and the result is almost always fatal. Drainage of a pneumococcal peritonitis is unwise; close the abdomen. It has been found that drainage of a peritonitis may bring about temporary relief and improvement, but in many cases there is a relapse in the patient's condition due to localization of accumulations of pus between coils of intestine or in the subphrenic spaces or in still more inaccessible places. It may be difficult to gain approach to these multiple intraperitoneal abscesses, and still more difficult to find them. Meanwhile the general condition of the patient becomes so unsatisfactory that nothing is of any avail in the fight against his failing resistance to toxæmia. Sometimes the relapse is due to a creeping peritonitis that defies all efforts to alleviate it, even by multiple drainage arranged to tap all the recognized "gutter" areas of the peritoneal cavity.

Peritonitis Arising from a Pelvic Source. It has been found that drainage of a peritonitis due to streptococcal infection arising from a septic uterus is quite ineffective, and it is undoubtedly the wisest course in these cases to treat the patient by sedatives. The same treatment applies to a general peritonitis following on pelvic infection due to pus leaking out of inflamed **Fallopian** tubes. Adopt conservative watching, local hyperæmia, Fowler's position, and sedatives; if a pelvic abscess develops, evacuate it by colpotomy.

Peritonitis from Internal Hæmorrhage. Whether bleeding into the peritoneal cavity comes from an injury to a solid viscus, hollow viscus or mesenteric or omental vessel, in the absence of other extravasations it is distinctly unwise to attempt any drainage. It is very much better to close the abdomen completely except for those cases in which gauze packing has been used in an attempt to arrest the bleeding.

Extravasation of Bile. Choleperitoneum may be due to accidental or pathological rupture of the gall bladder, or to post-operative leakage of bile following upon operations on the biliary tract; in cases of injuries of the liver even so slight as minute tears occasioned during a difficult cholecystectomy, bile may be secreted into the peritoneal space. In all instances the peritoneum must be opened, the bile carefully and completely evacuated and drainage arranged for both into the pelvis and down to the region of the foramen of Winslow. The results are not very happy in the post-operative cases of slow insidious bile leakage.

Extravasation of Urine. Peritonitis arising from extravasation of urine is somewhat fatal in its result. Immediately upon recognition, the lower part of the abdomen must be opened, the urine mopped out, the bladder rent sutured, and a wide bore rubber tube must be introduced down the recto-vesical pouch. At the same time, the bladder must be kept as empty as possible by the use of an indwelling catheter attached to some form of suction apparatus.

Local Peritonitis.

The expression "local peritonitis" often signifies that the irritation of the peritoneum, probably by organisms, has been met with such success on the part of the tissues that an intraperitoneal abscess has resulted. If so, it is a clear duty in almost all cases to undertake an operation designed to secure the best possible drainage of the pus.

Appendiceal Abscess. Abscess around an appendix is dealt with at the Royal Prince Alfred Hospital in a surprisingly varied manner. Analysis of the records shows that simple drainage of the abscess without attempting to remove the inflamed appendix at the time is the most popular, and the results as regards saving the patient's life are excellent. The drainage tube was taken out at periods varying from three to twelve days without apparently effecting much difference to the time of healing of the wound or the duration of the patient's stay in hospital. The average figure for the patient's stay in hospital seems to have been about twenty-four days, though some left in fourteen days and others were in hospital for as long as forty or fifty days. In spite of this minimal operation of simple drainage, a small percentage died. Other surgeons appeared rather to favour the removal of the appendix from the abscess cavity whenever reasonably possible, and, contrary to the usual teaching, these patients seemed to fare better than those in whom simple drainage only had been carried out. However, there was no standardization in the information available as to the relative severity of the abscess found at operation. The records show that there is a recent tendency to withhold any operation whatever in those cases of appendiceal abscess in which the patients present themselves for operation after the illness has been in progress for more than forty-eight hours. The results are satisfactory in the majority of instances. However, some degree of clinical experience is necessary in the discrimination of the type of appendiceal inflammation that is safe to entrust to the Oschner-Sherren treatment.

It was noted that in a large number of cases infection of the abdominal wall occurred. Suppuration and abscess formation are more likely to arise in the deeper part of the subcutaneous fat. Drainage is readily effected by the removal of sutures and the opening up of a track by the aid of sinus forceps. Subsequent fomentation assists the escape of pus and accelerates healing. If suppuration

occurs in this fatty layer, it is wise to note that pus may gravitate downwards in this plane as far as the suprapubic region, so that a counter-incision may be necessary at this site. As the patient is nursed in the Fowler position, this counter-incision provides dependent drainage.

Subphrenic Abscess. The hospital practice in subphrenic abscess is that drainage must be provided by the transpleural route. The technique adopted is entirely the usual method. The tube is gradually shortened and finally removed in twelve to fourteen days. The sinus may persist for some weeks longer; pocketing of pus must be watched for, and the sinus probed from time to time.

Pelvic Abscess. Pelvic abscess has already been dealt with elsewhere in this article.

Omental Abscess. Residual abscess resulting from a general peritonitis of low grade virulence offers a difficult problem. Laparotomy incision should be planned over the mass under suspicion and careful exploration usually discloses the inflammatory area. This mass should be gently brought as close to the surface as possible; it is opened and a rubber drainage tube is inserted into the abscess and is brought out through the main wound or through a stab wound nearby. The tube is removed in about ten days, by which time a walled off sinus has formed which gradually closes spontaneously.

Abscess of Diverticulitis. The treatment and drainage of abscess of diverticulitis are very similar to those of appendiceal abscess.

Drainage of the Pancreas.

Acute pancreatitis usually demands urgent drainage. A large tube is inserted through the laparotomy incision directly down into the damaged pancreas. It is wise to protect the surrounding skin from excoriation by the application of vaseline. The tube is removed in about ten to fourteen days.

Drainage of the Intestine.

In acute intestinal obstruction one of the most important indications for treatment is the attainment of drainage of the impounded contents of the bowel proximal to the site of obstruction. This is very much better secured by the removal of the cause of the obstruction and the employment of internal drainage, that is, by way of the lumen of the gut itself.

The onward passage of the contents may be aided by the careful use of aperients and by doses of pituitrin and eserine, as well as by the giving of stimulating and evacuating enemata, such as a quinine sulphate enema. If it is impossible at the time of emergency to relieve the occlusion of the lumen of the bowel, immediate drainage of the distended proximal segments must be arranged for by means of an enterostomy, caecostomy or colostomy. The results of jejunostomy in intestinal obstruction at the hospital have been disappointing.

Drainage of the Stomach.

The operation of gastrostomy carried out for the relief of starvation arising from complete obstruction of the œsophagus or cardiac end of the stomach, is not exactly an operation for drainage, but the same ideals of technique hold. Gastro-enterostomy is an excellent example of closed internal drainage, inasmuch as the contents of the stomach are prevented from leaving it by way of the pylorus (since pyloric obstruction is the ideal indication for the operation), and the anastomosis is carried out at a site that provides adequate dependent drainage. The question of drainage in perforation of a gastric or duodenal ulcer has already been discussed.

The Biliary Tract.

The Gall Bladder.

Cholecystostomy. Cholecystostomy is the operation that provides external drainage of the gall bladder, and records show that it is a most useful proceeding. It fulfils all immediate requirements in those cases of cholecystitis in which the inflammation is very acute, associated with great distension, threatened gangrene, empyema, hepatitis and cholangitis. If the head of the pancreas is acutely

inflamed or congested, gall-bladder drainage is strongly indicated. In short, the simple operation of cholecystostomy relieves tension, evacuates inflammatory products and encourages the recovery of the whole of the biliary tree. In addition, it is an operation that is easy of performance, quicker in execution, and which is definitely less shock-producing than the more formidable cholecystectomy. At this hospital there is ample evidence that this good operation retains its popularity. The technique employed is entirely orthodox. The drainage tube is removed in about ten to twelve days, and the fistula closes spontaneously within another few days, provided there is no obstruction to the cystic or common duct.

Cholecyst-duodenostomy. Cholecyst-duodenostomy is the operation that provides internal drainage of the gall bladder, and it seems that this rather difficult performance is usually carried out for the relief of the distended gall bladder associated with obstructive jaundice arising from stricture of the common duct or carcinoma of the pancreas. The results have been satisfactory. The internal fistula is infinitely preferable to an external fistulous tract which so distresses the patient by the continual outpouring of bile into the dressing.

Drainage after Cholecystectomy. In the great majority of cholecystectomy cases a rubber tube is placed down to the region of the stump of the cystic duct, so as to collect any possible seepage of bile from fine splits in the liver, from the gall bladder bed, or from minute accessory cystic ducts, as well as vascular oozing. The tube is taken through the abdominal wall by a stab wound located out towards the flank. The main incision is closed completely as far as is possible. The tube is removed in thirty-six to forty-eight hours. Cases are on record in which extravasation of the bile into the peritoneum has occurred subsequent to the removal of the tube, and in this connexion the suggestion may be made that the routine lifting of the patient into Fowler's position is in some measure responsible for this disaster, inasmuch as any escaping bile is liable to pass by the internal mouth of the tube since it is encouraged to gravitate down into the pelvis. Sometimes our surgeons, thinking that conditions are perfect, close the abdomen without drainage, and the results seem to justify this course. However, if there is the slightest doubt, drainage is recommended.

The Common Duct.

In all occasions in which the common duct is opened for exploration, a drainage tube is introduced through a stab wound in the flank, and extends down to the region of the foramen of Winslow. It is left there for two or three days. If there is the least suspicion of infection of the duct, a catheter of about size eight or ten is inserted right through into the common duct itself so as to drain away the main output of bile as well as inflammatory products. When this tube comes out in about four or five days, there is an escape of bile for a further few days, but this is led away by another tube that leads to the foramen region. The most efficient drainage of the common duct is an amply patent papilla of Vater, and steps should always be taken to assure its dilatation by Hegar's dilators. If it is utterly impossible to attain a sufficient patency of the common duct outlet, then a permanent fistula between the duct incision and the skin surface is inevitable. This is such a serious disability that a cholecyst-duodenostomy, cholecyst-gastrostomy, or an anastomosis between the dilated common duct proximal to the obstruction and the duodenum must be attempted.

Drainage of the Bladder.

The practice regarding bladder drainage varies according to the nature of the operation. Generally speaking, attempts are made to close the bladder if a cystotomy has been performed, and the bladder is drained by means of an indwelling catheter attached up to a suction apparatus. A suprapubic rubber drainage tube is inserted down to the suture line. This tube is removed in about three to five days. The suprapubic drain saves extravasation of urine into the cellular tissues of the cave of Retzius. Indwelling catheters are left undisturbed for periods varying from seven to twelve days. If a suprapubic cystostomy has

been performed, the tube introduced into the vesical cavity is taken out as quickly as possible, probably in four to six days, then a catheter is inserted into the bladder *via* the urethra, and a suprapubic drain is substituted that passes down to the opening of the bladder wall only, but not into the bladder. The urethral catheter is removed in ten to twelve days, and the drain of the extravesical tissues is taken out in five or six days. Any suprapubic sinus closes within two or three weeks, provided there is no obstruction to the free and ready emptying of the bladder *per urethram*. Variations and modifications of the above technique apply to the after-care of suprapubic prostatectomy, cystostomy, lithotomy and the repair of injuries of the bladder.

In all cases of open operation on the urethra for trauma or pathological lesions, a perineal drain is used, and the tube is taken out when there is no longer any urinary escape, or when the wound is sufficiently open to insure adequate drainage, which is usually about six to eight days.

Renal Drainage.

In cases of pyelitis the pelvis of the kidney is evacuated by medical or surgical drainage. The intake of large quantities of fluid may sufficiently flush out the pelvis, or so dilute the turbid urine as to enable it to escape freely down the ureter. Sometimes an indwelling ureteral catheter is introduced and left *in situ* for a few days. After the operation of pyelotomy for removal of renal calculus, the pelvis is sutured, but a rubber glove or tube drain is introduced through the flank down to the perirenal cellular tissues. It is removed in about four days, provided the ureter has been proved to be patent. Perirenal abscess is evacuated and drained in the manner usually adopted for a deep cellular abscess, and the tube is shortened daily, eventually being taken out in about ten days.

Drainage in the Neck.

The insertion of a small calibre rubber tube into the lower angle of the wound left after the removal of the triangles of the neck is standard practice at the Royal Prince Alfred Hospital. The tube is intended to lead off the products of capillary oozing and tissue serums, and is removed in thirty-six to forty-eight hours. In the same way in the majority of instances in which thyreoidectomy has been carried out, a small tube is placed into the space resulting from the removal of the thyreoid lobe, and in almost all cases it is inserted through a very small stab wound in the mid-line just half an inch below the main incision. This tube is taken out in thirty-six hours. In cases of Ludwig's angina as many drains as are necessary are introduced into the areas of suppuration.

Drainage in the Mouth.

After operation within the mouth no drains are used, but the escape of pus and fluids is facilitated by the use of hot mouth washes.

Drainage of the Scalp.

It is not usual to provide any outlet in a scalp wound after deliberate operations thereon, but in traumatic cases interrupted sutures well spaced out allow the escape of blood serum and inflammatory products. If there is deep seated suppuration in the scalp, incision and drainage by tubes is carried out as elsewhere.

Drainage of the Intracranial Spaces.

The only indication for drainage of intracranial spaces is the presence of abscess or uncontrolable oozing. In the former, a rubber or metal tube is inserted, and in the latter gauze packing is brought out through an angle of the wound. Gauze is gently removed in five to seven days.

Drainage of the Axilla and Breast.

It is the standard practice to leave a short rubber drainage tube into the lowermost part of the axillary space by way of a stab wound, in all cases in which the axillary contents have been excised. In the operation for the radical

removal of the breast, drainage at the epigastric end of the incision as well as in the axilla is the usual procedure. Mammary abscess is still opened and drained in the conventional fashion.

Drainage of the Pleural Cavity.

In recent times the surgical staff has adopted the modern accepted methods for the drainage of the pleural cavity in cases of empyema. The old established open drainage employed in the pneumococcal types of empyema in which the pus is thick with masses of fibrin is still used with quite satisfactory results. In more recent examples the method of "closed" drainage has been adopted, and the record seems to indicate that the results are an improvement. Irrigation of the pleural cavity witth Dakin's solution has been tried with varying success. Most of the surgeons empty and remove pulmonary hydatid cysts by the one-stage operation, and close the chest wall without drainage, unless there is any suspicion of suppuration. The total of experience in the problem of surgical drainage of pulmonary abscess and bronchiectasis is not great enough to give an account of methods and results. Medical and postural drainage is still the principal fashion adopted.

Drainage in Osteomyelitis.

As far as statistics show, the time-honoured procedure of trephining the compact bone so as to open the bone marrow cavity freely, or the use of an open gutter, still holds first place in the evacuation of pus in the medullary cavity. Open drainage by leaving the wound widely open, and the changing of the gauze at regular intervals has its exponents, but some of the staff have adopted the Winnett-Orr treatment. There does not appear to be very much difference in the ultimate results.

Drainage in Septic Joints.

The general scheme now adopted in draining septic joints is the placing of the tubes down to openings in the joint capsule, but no tube is introduced into the cavity unless the joint is hopelessly disorganized. Wounds involving a joint are excised and resutured without drainage, which may be supplied later if sepsis intervenes. In some cases the turbid fluid of a joint has been evacuated by repeated aspiration with very satisfactory results.

Drainage of Open Fractures.

Opinion and practice vary greatly as to the appropriate and best way of dealing with open fractures. Perhaps there is a tendency at present to excise the wound and to close the area without drainage. The result in suitable cases is admirable. If there is doubtful soiling or obvious contamination, records show that leaving the wound wise open is the best course. Free drainage saves both life and limb.

Summary.

1. Surgical drainage is a very important problem that confronts the surgeon both at operation and in after-care. Disasters may be averted and healing accelerated by timely and suitable drainage.

2. Convalescence is rendered more smooth, and the patient is quickly relieved of toxæmic effects.

3. Observation in the operating theatres and in the wards shows that there has not been any very radical changes in the selection of cases suitable or unsuitable for drainage.

4. Records and practice disclose that the more experienced the surgeon becomes, the more he is inclined to revert to draining doubtful cases.

5. Compiling an article or forming an opinion based on records is very difficult, as misleading conclusions may easily be arrived at in the absence of personal knowledge of the peculiar circumstances of the operation, the pathological state, and the general type and health of the patient.

6. An attempt has been made in the article to describe the current practice of the surgical staff of the Royal Prince Alfred Hospital.

Case Reports.

A CASE OF RUPTURED JEJUNAL DIVERTICULUM.

By RICHARD FLYNN,
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D.G., AGED forty-nine years, a male, a butcher by occupation, was admitted to hospital as an "urgent case", complaining of pain in the abdomen, vomiting and weakness for thirty-six hours.

His history was that up to eight weeks previously he was quite well, but at that time felt "deadly pains in stomach". The pain was extremely severe and continuous, causing him to sweat and writhe. He vomited immediately after the onset of the pain. These symptoms gradually subsided in a period of two to three weeks, and for the last two weeks the patient felt well.

At 1.30 p.m. on the day previous to admission the patient again noticed the "deadly full feeling" after his mid-day meal. Fifteen minutes later he suffered agonizing abdominal pain accompanied by immediate vomiting. The severity of the pain caused him to cry out and to become bathed in a cold sweat. The pain increased in severity, radiating all over the abdomen and to the testicles and back. He had no shoulder pain. He could eat nothing, felt very weak, and would cry out with pain if he attempted to move. There was nothing of importance in his previous medical history.

On examination, the patient was found to be shocked. His tongue was dry and furred, and he had marked oral fœtor. His abdomen moved slightly, his respirations were shallow and costal. On palpation his abdominal wall was tender and rigid, there was movable dulness in his flanks and liver dulness was diminished in the mid-axillary line. On examination *per rectum* marked tenderness was elicited. The diagnosis of an acute abdominal condition, most probably due to a ruptured duodenal ulcer, was made.

Under anæsthesia induced by the open method an upper right paramedian incision was made. On opening the peritoneum some clear straw-coloured fluid escaped. The duodenum and stomach were examined; no ulcer was found, but a mass to the left of the middle line was palpated. This proved to be a coil of kinked intestine covered by a thick yellow exudate. The site was the upper part of the jejunum 15·0 centimetres (six inches) from the duodenal-jejunal flexure and the bowel above and below the inflamed mass showed well marked distension and many diverticula. A diagnosis of ruptured diverticulum of the jejunum was made. Forty-five centimetres (eighteen inches) of small bowel were resected and side-to-side anastomosis was performed. Three rubber drainage tubes were inserted, one into the pelvic cavity and one into each flank. The abdomen was closed and the patient returned to the ward in good condition. An intravenous injection of saline solution and glucose was given.

The patient complained of severe shoulder pain about twenty-four hours after operation; the pain persisted for two days. He developed a well marked left basal pneumonia, but after a stormy convalescence he completely recovered.

Comment.

The ætiology of duodenal and jejunal diverticula has been very exhaustively discussed, and the literature reviewed by Evans[1] and Odgers.[2] However, this case is of especial interest on account of the rarity of reports of patients in whom

jejunal diverticula gave rise to clinical symptoms. The greater number of reported examples of this condition were found at *post mortem* examination of persons whose death was due to other causes.

Monsarrat[3] reported an acute abdominal crisis due to a ruptured diverticulum of the duodenum. There are several cases reported in which jejunal diverticula

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gave rise to intestinal obstruction. After a search through the available literature, I can find no report of a case of a rupture of a jejunal diverticulum giving rise to the symptom complex of "acute abdomen" as did the case here reported.

The accompanying figure shows an X ray photograph of the excised bowel after injection with bismuth paste. Many diverticula are well demonstrated, and the arrow (B) points to the leaking of the bismuth through the ruptured diverticulum into the surrounding inflammatory mass (A).

References.

[1] A. Evans: "Developmental Enterogenous Cysts and Diverticula", *The British Journal of Surgery*, 1929, Volume XVII, page 34.

[2] Odgers: "Duodenal Diverticulosis", *The British Journal of Surgery*, 1930, Volume XVII, page 592.

[3] K. Monsarrat: "Acute Perforation of Duodenal Diverticulum", *The British Journal of Surgery*, 1926, Volume XIV, page 179.

CLINICAL INSTINCT.

AMONG the writer's friends is a man whose reputation as a *raconteur* is second only to his renown as a pathologist. Of the few of his stories which are not of an exotic nature, the following is a good example:

At a medical school in London a competition took place for the best definition of "clinical instinct". The second prize was awarded to the man who wrote that it was "the faculty which every man thought he had and other people had not". The winner of the first prize defined clinical instinct as "blind man's bluff".

It is not our purpose to question or criticize the award. As a terse expression of irony, the latter is difficult to beat, and the former possesses the grain of truth which is the bane of all half-truths, even if it is not free from objection as the requisite definition.

As yet, no satisfactory definition of instinct has been arrived at: that of Romanes in a former edition of the "Encyclopædia Britannica", in which he says that "instinct is a generic term comprising all those faculties of mind which lead to a conscious performance of actions that are adaptive in character but pursued without necessary knowledge of

the relation between the means employed and the end attained", has, we are told, been criticized both from the biological and from the psychological standpoint; yet it conveys the essentials of a conception of the meaning of the word, the chief being the want of appreciation of the relation of "means to end".

Of this, numerous characteristic examples from the animal kingdom come to one's mind; for instance, for what purpose does the song thrush, alone among British birds, line her nest with mud, and what is the nature of the instinct which prompts untaught generations of thrushes to continue the habit?

This most interesting subject of the nature of instinct in animals could be pursued *ad nauseam*; but our interest is in clinical instinct, and when used in this sense it relates to a mental faculty in relation to disease which is well understood.

When viewed from a common and admittedly a narrow angle, both the above-mentioned definitions agree in admitting that clinical instinct exists even if, as the cynical epigram suggests, it is a subconscious illusion rather than an intellectual sixth sense.

There may be those who read these lines and question this contention. It may be held that clinical instinct is a process of mathematical deduction, based on knowledge supported by logic; and the writer would be the last person to question the value of logical deduction in diagnostic methods. Sound diagnosis is based so largely on logic that Bishop Butler's aphorism, "probability is the soul of life", might almost be written over the entrance of every ward.

Nor can it be allowed that clinical sense, insight, or instinct, is an acquired attribute, the result of study which grows with learning.

Examples spring at once to the mind of most knowledgeable doctors —some of them teachers, so that our opinions of them are without question—who even at the end of a long life of educating medical students entirely failed to acquire any clinical sense. To this class of mind, the case under discussion is always an exact replica of one which one read last week in a foreign journal: a hitherto undescribed disease of which one had not previously met with an example. Conversely, there are at all times in almost every hospital men who overflow with clinical insight—in one it seems to be a quality of sight, in another of smell— there is, in fact, no one of the five senses which may not be the alleged source of this faculty, though in the judgement of many its origin is

so peculiar and mystical that it is attributed to a sixth sense peculiar for this purpose.

Less gifted mortals are prone to think that these supermen just set eyes on a patient and the correct diagnosis rises to their lips; this is not usually a fact. As a rule, their deductions are the result of careful and logical observation; in many cases arrived at only after prolonged thought of which we do not see all the connecting ideas. It appears to the writer that careful observation is the key to their wizardry: as in the "Arabian Nights", attention to minutiæ was successfully relied upon by Zadig searching for a lost camel, so those who have not the gift of clinical insight must be classed among those who, in the words of the psalmist "have eyes and see not".

Whilst most often met with in the older generation, it is not rarely met with in quite young men, so, though fostered by experience, it cannot be regarded as one of the very few compensations of age. It is in fact in its supreme form a mental state with which one is or is not born: can one look forward to the day when proof of the possession of this faculty estimated by response to some stimulus will be a compulsory part of the preliminary medical examination? Perhaps in that enlightened age the methods of examination now in use will have been superseded by investigations of a more modern nature.

Yet it must be admitted that the majority of men possess some degree of clinical insight, though in this age of scientific aids to diagnosis it is apt to be hidden, if not destroyed, by a jargon of memorized formulæ: a temporary fashion sheds an apparent popularity upon the writings and sayings of those versed in the latest laboratory methods, but the practical teacher of medicine can never fail to realize the appreciation which is forthcoming when he makes an appeal to the clinical sense of his class.

Such appeals stimulate and encourage the growth of clinical insight, and without doubt often lead the pupil to the happy realization that this faculty is one of, if not, the, most valuable aid to scientific medicine.

C. H. FAGGE.

Surgery in Other Countries.

[*In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.*]

ABDOMINAL HYSTERECTOMY.

G. Labey, R. Fayot and O. Guihéneuc, *"Technique de l'hystérectomie abdominale subtotale totalisée", Journal de Chirurgie,* Volume xxxix, May, 1932.

THE authors have set out to show that the difficulties and risks of total hysterectomy for non-malignant conditions, as it is usually performed, can be avoided.

One of them, after having performed subtotal hysterectomy for many years, now usually does total hysterectomy, but it is done in two steps: (i) subtotal hysterectomy, (ii) enucleation of the stump of the cervix.

In most cases it is said to be more convenient to eliminate the body of the uterus (particularly if it is enlarged or if its adnexæ are the seat of inflammatory reaction), and then to enucleate the cervix from the vaginal vault, than it is to perform total hysterectomy as a one stage operation.

The enucleation of the cervix, based on a method expounded by Richelot in 1897, consists in the detachment of the cervix from its vaginal (and ligamentous) attachments, without usually encountering blood vessels which need special ligation. It is necessary to keep to the correct anatomical plane to do this. The plane is between the smooth, white, resistant tissue of the cervix and the tough, pliant connective tissue, which is on the deep surface of the vaginal mucous membrane. When working in this plane it is impossible to do any damage to the ureter, and because the surgeon works inside the area in which the larger branches of the cervico-vaginal vessels are found, it is extremely unlikely that he will encounter any blood vessel which needs special ligation.

Discussing the surgical anatomy, the authors point out that the vaginal vault is attached to the cervix along a circular belt which runs at right angles to the long axis of the cervix. The vaginal mucous membrane is in continuity with the mucous membrane covering the vaginal portion of the cervix, but on the deep surface of the mucous membrane covering the cervix there is a connective tissue layer which is less vascular, more dense and richer in fibrous and elastic bundles than is the connective tissue layer in the lower part of the vagina. Between this layer and the wall of the cervix is the surgically bloodless zone referred to previously.

The cervix is supplied by branches from the uterine artery. The vaginal vault is supplied by a branch of the uterine artery, which arises just after the latter crosses the ureter. This branch—the cervico-vaginal branch—divides into many small branches, which supply the walls of the vaginal vault (that is, the mucous membrane covering the vaginal portion of the cervix), and these small branches anastomose with the branches of the uterine artery, which supply the substance of the cervix; but the anastomosis takes place through very fine vessels of "hair-like" calibre, so fine that they are usually surgically negligible.

Technique: This step of subtotal hysterectomy in the operation calls for no special comment, except that the bladder need not be reflected so far from the cervix as is necessary when total hysterectomy is done by other methods. The uterine artery is ligated about the level of the internal os, and it need not be ligated lower down. A special point is made of leaving long the ligatures of the round ligaments and uterine arteries, and forceps are attached to the long ends. Tincture of iodine is applied to the cervical stump.

In the enucleation of the cervix gauze packs are used to isolate the cervical stump; the stump is then grasped with strong forceps, and firm traction is applied while enucleation is being performed.

The enucleation is done with a pair of long scissors with a blunt flat point and curved on the flat. After a little experience, it is not difficult to find the avascular layer. The pink, tough, pliant paravaginal tissue is dissected from the smooth, white, resistant cervix. This tough paravaginal tissue carries the vaginal mucous membrane, and contains a great conglomeration of extremely fine blood vessels, which increase in size enormously during pregnancy. It is necessary to keep to this plane to avoid bleeding, and having begun the enucleation in the correct plane, the surgeon works round the cervix taking all the cervical tissue. The point of the scissors is kept always against the tough resistant tissue of the
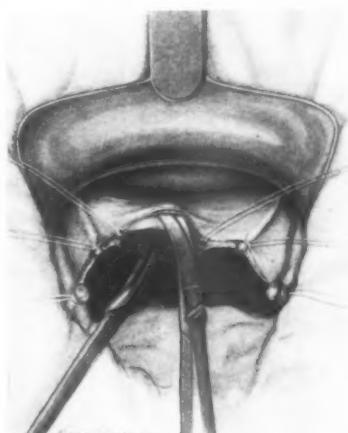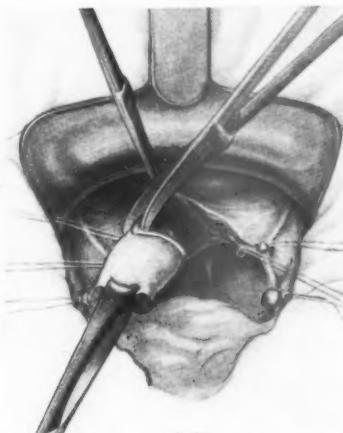

FIGURE I.   FIGURE II.

cervix, but the cervix is hardly ever cut into at all; and so the enucleation goes on; strong traction is being applied all the time to the cervical stump, and then, partly by snipping with the scissors and partly by tearing and pushing with the scissors or swab on holder, the cervix is freed. The lesser resistance of the vaginal wall is felt as the scissors reach the circumference of the upper part of the vagina.

By this method: (i) The whole cervix is removed. (ii) Neither the bladder nor the ureter nor the ligamentous attachments of the cervix is damaged. (iii) In most cases no bleeding points need ligation. (This method of enucleation of the cervix, in the performance of total hysterectomy, has been carried out by the present reviewer in a long series of cases with most satisfactory results. In his opinion the avascular plane is most easily found for the first time behind the cervix by snipping through the peritoneum along a line joining the line of the section of the two uterine arteries, and with strong traction on the cervix through the body of the uterus, and gentle cutting and pushing down with the scissors, the silver-white layer will readily show up.)

An opening being made into the vagina, the edges of its mucous membrane are grasped with forceps and a gauze pack is pushed down into the vagina towards the vulva. A loss of tone of the sphincter may result from the spinal anæsthesia, which is usually employed, and this may contribute to the expulsion

of fæcal matter. The pack is intended to prevent the contamination of the vagina, and is removed from below after the completion of the operation.

The upper portion of the vagina and the os are freely treated with tincture of iodine.

It is rare to have to ligate any cervico-vaginal vessels; any slight oozing will be readily stopped by the top suturing of the paravaginal tissues. However, if there be any inflammatory lesion in the pelvis it is frequently necessary to ligate bleeding points.

The round ligaments are attached to the vaginal vault on each side, the sutures, which were not cut short when they were applied, being used for this purpose with a Reverdin needle.

The peritonization calls for no special comment, except that the suturing is done so that no "dead" space is left.

Total hysterectomy is very much preferred to subtotal hysterectomy, and the technique of the operation just described overcomes very many of the difficulties and disadvantages of other methods of performing the operation.

R. F. O'SULLIVAN.

THE TREATMENT OF HERNIA OF THE POUCH OF DOUGLAS.

R. Crousse, *"La hernie vaginale postérieure et son traitement"*, *Bruxelles-médical*, Volume x, June 15, 1930, page 904. (Abstracted in *Journal de Chirurgie*, November, 1930.)

R. CROUSSE writes that vaginal hernia is said to be a very rare condition. It is certain that the anterior form is most exceptional, but the posterior variety is probably less uncommon than is supposed; in fact, it is probable that if all cases of genital prolapse usually considered as rectoceles are carefully investigated, it will be found that quite a number are true hernias.

Vaginal hernia is generally acquired, occurring in cases in which the pouch of Douglas is abnormally deep. Pregnancy, ascites, or an abdominal tumour favours its development. It is most often seen as a regular rounded swelling, covered on its surface by healthy mucosa, making a projection often to the vulval outlet, and presenting the usual characteristics of hernias, increase in size on straining, impulse on coughing and reduction with a gurgle. Vaginal examination supplements these facts, and rectal examination shows that the condition is not just a simple rectocele.

The principles of cure of vaginal hernia do not differ from those applicable to any other hernia. The usual incision for rectocele is made, the sac is isolated and ligated, and several purse string stitches are introduced, catching up the utero-sacral ligaments, the back of the uterine cervix and the serosa of the rectum. This insures complete closure of the internal orifice of the hernia. Colpoperineorrhaphy with accurate apposition of the lacerated *levatores ani* is then performed. Crousse in this manner operated upon a woman, aged forty-one years, who, two months before, after straining, had noted the appearance of a vulvar swelling which later attained the size of a goose egg. This operation was followed by a perfect result.

J. BUCHANAN.

TREATMENT OF DYSMENORRHŒA BY RESECTION OF THE PRESACRAL NERVE.

G. Cotte, *"Traitement de la dysménorrhée par la résection du nerf présacré. Résultats éloignes des interventions faites en 1924-1925"*, *Lyon médical*, Volume LXIV, Number 2, January, 1932. (Abstracted in *Journal de Chirurgie*, August, 1932.)

COTTE bases his opinion regarding the value of resection of the presacral nerves on a series of cases treated more than five years before. The thirty-six patients treated form two groups according as the treatment was undertaken for dysmenorrhœa without associated lesions or as a complementary procedure to other operations

upon the adnexa. The results are easily appreciated in the first group of twenty-two patients, but they are also excellent in the second group of fourteen patients. In the follow-up, twenty patients were seen. In all these cases (except one "improved") the dysmenorrhœa had vanished. These results are much superior to those of uterine dilatation, which gives about 50% good results. Besides, by resection of the presacral nerve, dyspareunia, leucorrhœa and bladder disturbances disappear or are very favourably influenced. Ten patients had had normal pregnancies.

Against this, the operation has little effect upon intestinal troubles, which would appear logical, as the large intestine is innervated by the inferior mesenteric plexus. The indications for the operation must not be extended beyond its possibilities and all pelvic pains must not be treated by this procedure, since many depend upon pelvic nerves which are not affected by this method.

In dysmenorrhœa in particular one should not operate for lumbar pains preceding the period, but only in the cases of uterine colic. Presacral nerve resection does not improve the crises of intermenstrual pain (due to ovulation) since the ovary is innervated directly by the inferior mesenteric plexus. For the same reason, the operation does not affect the menstrual cycle.

The failures attributed to the procedure, when not due to the complete nerve section, very often exemplify errors concerning the indications for operation. The late results obtained by Cotte show the efficiency of the method when the indications have been carefully considered.

J. BUCHANAN.

PULMONARY TUBERCULOSIS BECOMING MANIFEST AFTER EXTIRPATION OF A
LUNG HYDATID.

W. Denk, *Zentralblatt für Chirurgie,* Number 26, 1933.

DENK reports that a student, aged twenty-two years, had been suffering for a year from repeated pleuritic attacks, with cough, scanty expectoration, stitch-like pains and mild pyrexia. Clinical and X ray investigation revealed a hydatid cyst the size of a child's fist, situated in the upper lobe of the right lung. This was removed by a two-stage operation, but a pleural effusion developed, sterile to begin with and later showing pneumococcal and streptococcal infection. This effusion was drained and the wound then healed satisfactorily.

The point of special interest in the case is that fourteen days after removal of the cyst the sputum was found to contain tubercle bacilli, although before the operation there were none present, and the patient showed no indications whatever of an active or latent tuberculosis.

Denk concluded that there had been a focus of tuberculosis in the lung, but that the pressure exerted by the growing cyst had kept the tuberculous lesion latent, exercising a mechanical influence similar to that of an artificial pneumo-thorax. When the cyst was extirpated and the pressure on the tuberculous focus was removed, the disease flared up into temporary activity, thus accounting for the bacilli in the sputum. After a few weeks these bacilli disappeared and the patient recovered good health.

In the discussion on this case, J. Sorgo pointed out that the bacilli might have been liberated by the inflammatory complication, or that a small cavity had been able to empty itself after the obstruction due to the cyst had been removed. Nevertheless, he thought Denk's explanation reasonable, and in support he referred to an analogous case of lung tuberculosis flaring up after removal of a thoracic dermoid.

L. E. BARNETT.

Reviews.

PATHOLOGICAL CONDITIONS OF THE KNEE JOINT.

Internal Derangements of the Knee Joint: Their Pathology and Treatment by **Modern Methods.** By A. G. TIMBRELL FISHER, F.R.C.S. (Eng.). Second edition. London: H. K. Lewis & Company, Limited. Pp. 205 + xiv, with 120 illustrations. Demy 8vo. Price: 15s. net.

THE second edition of Mr. A. G. Timbrell Fisher's "Internal Derangements of the Knee Joint" maintains the same level of excellence which all the publications of that author enjoy. It is, in our opinion, the most complete and most learned exposition on the subject of internal derangements of the knee joint in British surgical literature.

The author has obviously devoted a vast amount of time to the study of the anatomy and physiology of the knee joint, and it is upon this basis that he attempts, we think, correctly, to explain the pathological conditions to which that joint is especially liable. The book is divided into two parts. The first deals with pathological conditions of the semilunar cartilages. It is here that we looked with interest for the author's explanation of the exact mechanism by which the internal semilunar cartilage becomes injured. The author states that in certain movements of the knee joint: "The anterior portion of the cartilage itself may be torn"; "the cartilage may even be torn from its attachments to the posterior fibres of the internal lateral ligament." But why and exactly how do these tears occur? Mr. Fisher appears to be unconvinced by the many ingenious explanations which have been put forward by various authors concerning this point. With this view we are in entire agreement, for it seems that the question of the exact and detailed mechanism whereby the initial derangement occurs is still to be answered.

The chapters on diagnosis and treatment, especially the latter, are excellent.

The second part of the book is devoted largely to the conditions of loose bodies and osteoarthritis, both of which subjects the author has dealt with in Hunterian Lectures to the Royal College of Surgeons of England. In this part of the book, the author's histo-pathological studies of bone and cartilage may quite correctly be regarded as classical.

The illustrations in the book are excellent and are particularly appropriate when taken in conjunction with the text. We have nothing but praise for this book, which should be studied by all surgeons. More particularly, it should prove invaluable to younger surgeons in helping them to decide when and how to open a knee joint for the relief of some form of internal derangement.

Proceedings of the Royal Australasian College of Surgeons

COUNCIL MEETING.

A MEETING of the Council of the Royal Australasian College of Surgeons was held in Melbourne on August 26, 1933, Sir Henry Newland, the President, in the chair.

The President made reference to the great loss which the College and the profession in general had sustained by the death of Robert Hamilton Russell, who was a founder of the College and its first Censor-in-Chief.

It was resolved that some form of memorial should be incorporated in the College building to perpetuate his name, together with those of the late George Adlington Syme and the late Robert Gordon Craig.

Election of Office-Bearers.

The vacancy in the number of elected members of the Council created by the death of R. Hamilton Russell was filled by the appointment of Balcombe Quick.

In accepting the resignation of Alan Newton from the position of Honorary Secretary of the College, the Council recorded its gratitude for the valuable work he had done in this position.

The following appointments were made:

Julian Smith, Junior, was appointed Honorary Secretary of the College for the remainder of Alan Newton's term of office.

G. R. A. Syme was appointed Honorary Assistant Secretary for the remainder of Julian Smith's, Junior, term of office.

Alan Newton was appointed Censor-in-Chief for the remainder of the late R. Hamilton Russell's term of office.

The vacancy in the position of Vice-President of the College, occasioned by the resignation of Sir Alexander MacCormick, was filled by the election of H. B. Devine.

Admission of Fellows.

The following candidates were admitted to fellowship:

New South Wales: Hugh Hunter Jamieson.
Queensland: Bruce Toomba Mayes, Clive Lansdell Paine.
Victoria: William Balfour Wishart.

The following Junior Members were admitted to fellowship:

New South Wales: Clifford Stirling Colvin, Ernest John Egan, Joseph Steigrad, Philip Neville Walker-Taylor.
Queensland: Patrick Leo O'Halloran.
South Australia: Ian Ayliffe Hamilton.
Western Australia: Stanley Earles Craig.

Permanent Headquarters.

In the original lease of the site of land in Melbourne upon which the permanent headquarters is to be erected, the College had been granted a long lease of the southern half of the site and a short lease of the northern half upon which it was encumbant upon the College to construct and maintain gardens.

The Executive Committee was pleased to report to the Council that, following upon negotiations with the Ministry of the State of Victoria, the College had been granted a long lease of the whole of the site and, furthermore, had been relieved of the duty of constructing and maintaining gardens upon the site.

The final plans of the College building had been approved, and the demolition of the building at present upon the site was already in progress. It was expected that the College building would be completed about the middle of 1934.

The formal opening of the permanent headquarters will take place in March, 1935, during the Centenary Celebrations of the City of Melbourne. Invitations had already been sent to prominent overseas surgeons asking them to attend this function.

Surgical Assistants at Clinical Schools.

The Melbourne Hospital, the Alfred Hospital and Saint Vincent's Hospital, Melbourne, and the Adelaide Hospital have recently instituted a scheme whereby

positions known as surgical assistants have been made available.   The scheme has also received the approval of the Committee of Management of the Royal Alexandra Hospital for Children, Sydney.   The Council hopes that positions similar to these may be made available in the other large clinical schools of Australia.   There is no doubt that positions of this nature afford candidates for fellowship the opportunity to obtain that practical training in surgery which is regarded as essential.

University of New Zealand.

The Council has been advised by the Vice-President, Sir Louis Barnett, that the Faculty of Medicine of the University of New Zealand has accepted the suggestion of the Council that marks should be given in anatomy and physiology at the final qualifying examination for the degree of M.B., Ch.B. of that University. This action will enable the following regulation, passed by the Council at its meeting on April 10, 1933, to be carried into effect:

> That candidates who obtained 70% or more at the special examination in anatomy and physiology at the final qualifying examination for the degree of M.B., Ch.B. (University of New Zealand), shall be deemed to have passed a primary examination as defined under Regulation 17.

Birthday Honours.

The following Fellows were included in the list of birthday honours: K.C.V.O., Sir Thomas Dunhill; K.B., Sir Hugh Acland; C.M.G., F. A. Maguire.

Alterations in the Articles of Association.

The Council has been advised by the Solicitor of the College that the special resolution altering the Articles of Association was duly approved by the Honourable the Attorney-General of the State of Victoria, and had been filed in the Registrar-General's Office.

Annual General Meeting.

The next annual general meeting of the College will be held in Adelaide on February 28 and March 1, 2, and 3, 1934.

Post=Graduate Study.

(FROM THE POST-GRADUATE BUREAU OF THE ROYAL AUSTRALASIAN COLLEGE OF SURGEONS, UNDER THE DIRECTION OF J. M. BUCHANAN.)

IN accordance with the policy of making available details of post-graduate instruction courses provided in Australasia and overseas, the Bureau has continued the work of collecting information regarding many of the well-known teaching clinics.

Graduates desirous of detailed information are cordially invited to apply to the Bureau, 6 Collins Street, Melbourne, for any assistance they may require.

An attempt has been made to secure a number of posts as ships' surgeons on overseas vessels for nominees of the Bureau who may have difficulty in securing such positions privately.   The proposition has been favourably received by the shipping representatives, and the result of the representation will be published in the next issue of the journal.

In this issue we publish details of the surgical clinics in Sydney, and the post-graduate facilities available.

Sydney Hospital.

Sydney Hospital is situated in Macquarie Street, Sydney, next door to Parliament House, covering an area of three and a half acres.

In conjunction with the hospital are two dispensaries—The William Perry Dispensary at Paddington, and the John Storey Memorial Dispensary, Regent Street, where out-patient treatment is carried out. At the hospital is the Kanematsu Memorial Institute of Pathology. Situated in Woolloomooloo, right opposite the Domain, is the Sydney Eye Hospital, which has fifty beds. This is part of the General Hospital, and is under the same administration. There are two senior honorary surgeons and five assistant honorary surgeons. Out-patients and in-patients are treated.

The Main Hospital contains 236 surgical beds, which are in constant use. During the year ended December 30, 1932, 4,280 patients with surgical conditions were admitted. The total attendances at the surgical outdoor department is 11,250.

In addition to general surgery, there are special departments for treatment of diseases of ear, nose and throat, eye and teeth, and in addition are departments devoted to gynæcology, orthopædics, pædiatrics, urology, fractures, radium clinic, X ray therapy and venereal diseases.

The organization of the hospital provides ample facilities for post-graduate clinical instruction in surgery, special courses being arranged from time to time. Opportunities for research are provided under the supervision of the staff.

Staff.

The general surgical staff of the hospital consists of four in-patient surgeons, five out-patient surgeons, and an assistant relieving surgeon, and four clinical assistants to surgical out-door department; the last-mentioned appointments are for one year.

Visiting practitioners are always welcome to the staff, who are glad to afford facilities for observing the work of the hospital.

Further information may be obtained from the Medical Superintendent.

Members of the surgical staff are:

General Surgery—Indoor Surgeons—
>   Dr. Skipton Stacy: Visits Monday and Friday, a.m.; operates Tuesday, p.m.
>   Dr. George Bell: Visits Tuesday and Thursday, a.m.; operates Wednesday, p.m.
>   Dr. Archie Aspinall: Visits Wednesday and Friday, a.m.; operates Thursday, p.m.
>   Dr. Howard Bullock: Visits Tuesday and Thursday, p.m.; operates Friday, p.m.

General Surgery—Outdoor Surgeons—
>   Dr. A. M. McIntosh: Out-patient clinic Monday and Thursday, 2 p.m.; operates Tuesday, a.m.
>   Dr. Lyle Buchanan: Out-patient clinic Tuesday and Friday, 2 p.m.; operates Monday, p.m.
>   Dr. Ramsay Sharp: Out-patient clinic Wednesday, 2 p.m.; operates, Friday, p.m.

Orthopædic Surgery—
>   Dr. J. Hoets: Out-patient clinic Tuesday, 9.15 a.m., Thursday, 2 p.m.; operates Tuesday, p.m.
>   Dr. R. V. Graham: Out-patient clinic Monday, 2 p.m., Wednesday, 9.30 a.m.; operates Tuesday, p.m.

Gynæcology—
>   Dr. C. V. Bowker: Visits Tuesday, p.m.; operates Thursday, p.m.
>   Dr. R. I. Furber: Visits Monday, p.m.; operates Wednesday, p.m.
>   Dr. Hubert Porter: Out-patient clinic Tuesday and Friday, 2 p.m.; operates Friday, a.m.
>   Dr. A. R. H. Duggan: Out-patient clinic Tuesday and Friday, 2 p.m.; operates Thursday, a.m.

Urology—
>   Dr. Reginald Bridge: Out-patient clinic Thursday, 2 p.m.; operates Tuesday, p.m., Wednesday, a.m.

The Royal Prince Alfred Hospital.

The Royal Prince Alfred Hospital is situated in Missenden Road, Camperdown, and is within the precincts of the University of Sydney. The new Rockefeller Medical School, which is now almost completed, is actually within its grounds.

The hospital contains 200 surgical beds, which are in constant use. In addition to general surgical, there are special departments for the treatment of diseases of ear, nose and throat, eye, teeth, and there are departments devoted to gynæcology, orthopædic surgery, urology, venereal diseases and radiotherapy (radium and deep X rays).

The organization of the hospital provides facilities for post-graduate work in surgery, and organized post-graduate courses are held at intervals. The general surgical staff of the hospital consists of six in-patient surgeons, including the professor of surgery, and six corresponding out-patient surgeons. Appointments as clinical assistants to the outdoor surgeons are available to graduates desirous of obtaining further surgical experience. These appointments are for one year, but may be extended for a second year.

Visiting practitioners are always welcomed by members of the staff, who are glad to afford facilities for observing the work of the hospital.

Further information will be readily supplied on application to the Medical Superintendent.

Members of the surgical staff at present are:

General Surgery—In-patient Surgeons—
>   Mr. F. P. Sandes: Visits Tuesday, p.m., Thursday, a.m.; operates Wednesday, p.m.
>   Sir John McKelvey: Visits Tuesday, p.m.; operates Thursday, p.m.
>   Mr. H. R. G. Poate: Visits Monday, p.m.; operates Tuesday, p.m.
>   Mr. J. C. Storey: Visits Friday, p.m.; operates Monday, p.m.
>   Mr. B. T. Edye: Visits Tuesday, p.m.; operates Wednesday, p.m.
>   Professor Harold Dew: Visits Monday to Friday; operates Thursday, p.m.

General Surgery—Out-patient Surgeons —
>   Mr. E. M. Fisher: Out-patient clinic Tuesday, p.m.; operates Wednesday, p.m.
>   Mr. T. M. Furber: Out-patient clinic Monday, p.m.
>   Mr. T. Farranridge: :Out-patient clinic Thursday, p.m.
>   Mr. W. D. McCredie: Out-patient clinic Tuesday, p.m.
>   Mr. R. Angel Money: Out-patient clinic Friday, p.m.
>   Mr. R. Flynn: Out-patient clinic Wednesday, p.m.

Gynæcology—In-patient Surgeons—
>   Mr. H. H. Schlink: Visits Monday and Wednesday, p.m.; operates Friday, p.m.
>   Mr. R. L. Davies: Visits Monday, p.m.; operates Tuesday, p.m.

Gynæcology—Out-patient Surgeons—
>   Mr. F. A. Maguire: Out-patient clinic Thursday, p.m.
>   Mr. C. L. Chapman: Out-patient clinic Monday, p.m.

Orthopædic Surgery—In-patient Surgeon—
>   Mr. L. G. Teece: Visits Friday, p.m.; operates Monday, p.m.

Orthopædic Surgery—Out-patient Surgeons—
>   Mr. L. G. Teece: Out-patient clinic Friday, p.m.
>   Mr. D. J. Glissan: Out-patient clinic Monday, p.m.
>   Mr. E. B. M. Vance: Out-patient clinic Wednesday, p.m.
>   Mr. F. H. Callow: Out-patient clinic Friday, p.m.

Urology—In-patient Surgeon—
  Mr. R. K. Lee Brown: Visits Monday, p.m.; operates Tuesday, p.m.

Urology—Out-patient Surgeons—
  Mr. J. W. S. Laidley: Out-patient clinic Tuesday and Friday, a.m.
  Mr. M. M. S. Earlam: Out-patient clinic Tuesday and Friday, a.m.
  Mr. R. K. Lee Brown: Out-patient clinic Tuesday and Friday, a.m.

Saint Vincent's Hospital, Sydney.

Saint Vincent's Hospital is situated in Victoria Street, Darlinghurst, within five minutes of the city. It is one of the three clinical school associated with the University, and is controlled by the Sisters of Charity.

The surgical beds in the hospital number 139, and 3,340 patients were treated in these beds during the twelve months ended June, 1933; 2,317 surgical operations were performed in the year. Twenty-five thousand persons attended the surgical out-patient clinics.

There are special departments for oto-rhino-laryngology, ophthalmology, gynæcology and orthopædics. A special division of the staff is organized into a Cancer Research Subcommittee, using a highly efficient deep X ray therapy unit. Radium therapy is used in the hospital.

Staff.

The surgical staff of the hospital consists of four in-patient surgeons and four assistant surgeons, organized into surgical units.

The special departments are organized into indoor and outdoor sections.

The members of the surgical staff are:

Surgeons—
  Sir John McKelvey: Rounds Monday, 2 p.m.; operations Wednesday, 2 p.m.
  V. M. Coppleson: Rounds Wednesday, 10 a.m.; operations Thursday, 2 p.m.
  C. Weston Maher: Rounds Saturday, 10 a.m.; operations Monday 2 p.m.
  W. Maxwell: Rounds Monday, 2 p.m.; operations Tuesday, 2 p.m.

Assistant Surgeons—
  W. Perry: Outdoor Monday, 2 p.m.; operations Tuesday, 8.30 a.m.
  Douglas Miller: Outdoor Monday, 2 p.m.; operations Monday 8.30 a.m.
  V. J. Kinsella: Outdoor Thursday, 2 p.m.; operations Thursday 8.30 a.m.
  E. McMahon: Outdoor Thursday, 2 p.m.; operations Friday, 8.30 a.m.

Gynæcologists—
  Constance D'Arcy: Rounds Monday, 2 p.m.; operations Tuesday, 8.30 a.m.
  F. A. Maguire: Tuesday, 2 p.m.; operations Wednesday, 8.30 a.m.
  F. Brown Craig: Rounds Wednesday, 2 p.m.; operations Thursday, 2 p.m.

Assistant Gynæcologists—
  D. S. Foy: Out-patients Friday, 2 p.m.
  C. Coghlan: Out-patients Tuesday, 2 p.m.
  M. Britnell Fraser: Out-patients Tuesday, 2 p.m.

Orthopædic Surgeon—
  D. J. Glissan: Out-patient, Wednesdays 2 p.m.; operations Friday, 2 p.m.

Further information may be obtained from the Dean of the Clinical School.

Royal Hospital for Women, Paddington.

The Royal Hospital for Women, Paddington, is situated in Oxford Street, opposite Victoria Barracks. It occupies eight acres of ground and extends from Oxford Street to Glenmore Road, Paddington.

The hospital is divided into obstetrical and gynæcological sections. During the year 1932 there were 3,851 patients admitted to the hospital; of this number 1,944 patients were confined; 1,406 obstetrical operations were performed, and 1,966 children were born.

In the gynæcological section 264 operations were performed, 374 patients were admitted to the Isolation Block and 281 operations were performed; 364 patients were admitted to the Waiting Home, and in the Outdoor Department 2,314 attended the antenatal clinics and 1,444 attended as gynæcological out-patients.

Special post-graduate courses are arranged from time to time; but post-graduates, by special arrangement, may reside within the hospital at any time during the year.

Staff.

The Honorary Medical Staff consists of six in-patient surgeons and five out-patient surgeons.

Visiting practitioners are always welcomed by the staff.

The members of the staff are:

Honorary In-patient Gynæcologists and Obstetricians—

Dr. Cedric Bowker: Attends Wednesday, 10 a.m.; operates Friday, 9 a.m.

Dr. P. L. Hipsley: Attends Monday, 2 p.m., Wednesday, 11 a.m.; operates Thursday, 9 a.m.

Dr. H. A. Ridler: Attends Monday and Friday, 10 a.m.; operates Wednesday, 9 a.m.

Professor J. C. Windeyer: Attends Tuesday, 2 p.m.; operates Wednesday, 2 p.m.

Dr. Constance D'Arcy: Attends Wednesday, 3 p.m., Saturday, 10 a.m.; operates Monday, 9 a.m.

Dr. F. Brown Craig: Attends Monday, Wednesday and Friday, a.m.; operates Tuesday, a.m.

Honorary Out-patient Gynæcologists—

Dr. Gordon Lowe: Attends Thursday, 2 p.m.

Dr. Bruce Hittmann: Attends Tuesday, 2 p.m.

Honorary Out-patient Obstetricians—

Dr. T. Farranridge: Attends Monday, 2 p.m.

Dr. Ida B. Saunders: Attends Wednesday, 2 p.m.

Dr. T. H. Small: Attends Friday, 2 p.m.

Editorial Notices.